NORTH CAROLINA STATE COLLEGE
School of Agriculture
RALEIGH, N. C.

May [illegible], 195[illegible]

Dr. [illegible] Scott
[illegible] Research Division, [illegible]
Beltsville, Maryland

Dear Dr. Scott:

Herewith is a [illegible]

There are [illegible]

I am also sending you [illegible]

[illegible]

880168

NORTH CAROLINA STATE COLLEGE
SCHOOL OF AGRICULTURE
RALEIGH, N. C.

May 8, 1961

Department of Horticulture

Dr. D. H. Scott
Crops Research Division, ARS
Beltsville, Maryland

Dear Dr. Scott:

Herewith is a copy of the report on Muscadine Grape Breeding. Now that it is put together, I am disappointed in it. It is too long, and yet it contains little information. However, it was only intended as an outline of the work done. The Tables are a bit confusing perhaps but the long ones are lists of crosses and of selections that are needed somewhere.

There are five typed copies with photos which I am distributing as follows: D. H. Scott, N. H. Loomis, F. D. Cochran, Underwood (office copy), myself. If more are to be typed, perhaps there will be some changes suggested.

I am also sending you a revised summary of grape material on hand and a classification of selections. These are more easily comprehended than the Tables in the report. I am not sure that all the totals agree.

Sincerely,

C. F. Williams

C. F. Williams
Research Professor

CFW/csd

Grape - Raleigh, N. C. - 4/12/61

Selections	Original	McCullers	Clayton	4x	Total
		Source of stock			
Possible release		6	1		7 (-2 early)
Test		11	13	3	27
Very good		10	32	1	43
Good			22	6	28
Breeding stock	5	6	12	8	31
Total	5	33	80	18	136

Seedlings, Muscadine		
Diploid		
Selected once	101	
Not selected	107	
Nursery rows	1130	approximately
Seed 1960		2049 seed (germination good)
Total	1338	
Polyploid		
Original colchiploids	20	
Radiated Higgins	1	
4x selections	18	
Seedlings in vineyard	28	
Seedlings in nursery	134	
3x and treated	54	
Total	255	
Species Hybridization		
Original 2n hybrids	6	
Colchiploid selections	12	
6-15 and 6-16 progeny	347	
4x from 4x crosses	25	
Colchiploids of 1959	154	
Colchiploids of 1960	46	
3x and treated	77	
Total	649	
1960 seed	408	potted

Classification Grape Selections 4/12/61

from McCallum's

from Clayton

I	II	III	IV	V	VI
Release	Test	Very good	Good	Stock	Dis~~eased~~card
27-262	11-173	5-63		B6-19	
29-193	11-186	9-1		V21 R15 B2	
9-305	27-128	9-308		G 52	
60-60	29-32	15-161		25-8-26	
59-32	29-115**	15-165		37-10-1	
	29-156*	17-197			
	33-13	20-30		20-119	11-178
	33-98*	27-229		28-193	17-55
	44-15*	27-354		28-222	33-9
	57-56**	29-47		44-47	56-98
	15-229 } Early (release?)	33-106		46-15 F	
	115-180 }	58-89 F		64-53	
	77-21				
	77-61	77-51	73-48	DS 56	
	81-41	77-108	74-103	DS 127	
	85-172	77-194	79-9	72-76	
	86-12	77-123 F	80-68 F	72-109	
	88-9	80-74	84-82	73-84	
	88-102	80-114	88-67	74-110	
	104-8	80-153	88-120	85-90	
	108-109	80-169 F	100-8	94-4	
	108-169	81-16	100-23	95-162	
	109-21	83-52	100-29 F	95-167	
	109-157	84-56	100-40	101-35	
	110-34	84-92	101-18	116-272	
		85-47	108-74		
		85-122	110-93		
		86-156	111-47		
		87-56 F	111-108		
		87-102	111-113		
		89-12	112-65		
		89-40	115-146 F		
		89-52	115-259		
		92-18	116-189		
	4x C 72**	93-26	136-9		
	4x C 98**	101-12			
	4x 131-12**	103-35			
		106-5	4x C 47		
		109-34	4x C 62		
		109-82	4x C 79		
		109-120	4x C 90		
		109-174	4x C 102		
	4x 226-11**	109-186	4x C 105		
		116-68			
		136-22			
		4x C 57			

F = female, all others hermaphrodite.

Explanation of classification

I. Increase for release to nurseries for propagation and to cooperators for testing - also Willard and Jackson Springs.

II. Increase for testing at Clayton, Willard, Jackson Springs
Coop. Miss. Sta., Miss. Loomis, Georgia Sta.
Coop. Barnes, Onslow Winery, Ownes (Georgia)

III. Two each at Clayton (and as many as possible at Willard and Sandhills)
Coop. Miss., Loomis, Georgia (Owens)

IV. Save - some may move up to III or to V and VI

V. Be sure to save the 5 original and the 6 from McCullers.

Some of I, II, III, are already with Loomis and Georgia and other Stations.

MUSCADINE GRAPE BREEDING

1945-1961

C. F. Williams

North Carolina Agricultural Experiment Station

In cooperation with

Crops Research Division, U. S. Department of Agriculture

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TABLES

Diploid Breeding

Tables continued

Polyploid breeding

Species hybridization

Tables continued

24. List of grape material at the North Carolina Experiment Station, January 1, 1961.

I. Muscadine

1. Overhead arbor

A. Varieties

B. Older numbered selections

C. Selections from McCullers Research Station

Best

Very good

Good

Stock

Probable discard

2. Vertical trellis

A. Selections

Best

Very good

Good

Stock

B. Seedlings planted

C. Seedlings in nursery rows

D. Seed of 1960 crosses - sown Feburary 6, 1961

E. Tetraploid Selections

II. Species hybridization

A. Parental material

B. Species-hybrid selections

C. Species-hybrid seedlings (not colchicine treated)

D. Species-hybrid seedlings (colchicine treated)

E. Triploid species-hybrids

F. Crosses of 1960, seed planted February 6, 1961

Figures

1. Comparison of size of berry in relation to the number of seeds per berry for 2n and 4x vines of selection NC 11-178.

2. Comparison of size of berry in relation to the number of seeds per berry for 2n and 4x vines of selection NC 20-30.

3. Comparison of size of berry in relation to the number of seeds per berry for 2n and 4x vines of selection M7.

4. Comparison of size of berry in relation to the number of seeds per berry for 2n and 4x vines of selection M10.

Photographs

1. NC 111-108 [Latham x (Lucida x Burgaw)] Light fruited selection with large clusters of persistent berries. Clusters with desirable long stems.

2. NC 94-4 [(Thomas x Burgaw) x (Scuppernong x Tarheel)] Dark fruited selection with large compact clusters. Vine is very productive, but the fruit is rather acid.

3. NC 60-60 [25-8-26 x (Topsail x Tarheel)] Light fruited selection, with large fine flavored fruit.

4. NC 59-32 [Lucida x (Topsail x Tarheel)] Light fruited selection with large very attractive berries.

5. NC 89-48 [(Scuppernong x Tarheel) x (Topsail x Burgaw)] Very productive, light fruited selection. Berries attractive and fine flavored.

6. NC 93-26 [(Latham x Burgaw) x (Thomas x Tarheel)] Very productive, black fruited selection. Clusters too compact and short stemed for easy harvesting. Sweet and good flavored.

7. Creek (4x) Original colchiploid vine showing very good vigor, equal to that of the diploid form. Canes are of the past season, unpruned.

8. Dulcet (4x) Original colchiploid showing severe dwarfing. Vine is the same age as Creek vine in Figure 7. Photo taken from shorter distance and the vine appears proportionally larger than it is in comparison with Creek. Canes show several years of growth.

9. Berries of 2n (left), and 4x (right) NC 20-30, showing difference in size.

10. Two year old seedlings of 4x (left) and 2n (right). Note the short compact root systems and short internodes of the 4x seedlings.

11. One year old seedlings of 2n crosses (left) and 4x crosses (right).

12. Two year old seedling of 4x crosses (left) and 2n crosses (right).

13. NC 6-15 (2n), many of the canes on this vine were winter injured.

14. NC 615-11 (2n). Seedling from open pollination of NC 6-15 (probably by V. rotundifolia). This seedling is perfect-flowered, fertile and has a relatively large flower cluster.

15. Row of colchicine treated species-hybrids. Cross of 1958, treated 1959, photo September, 1960.

16. Species-hybrids treated with colchicine.

17. NC 226-11 (4x) (Golden Muscat x NC 60-60). Cluster on colchicine treated species-hybrid, first year from seed. Cluster of 32 berries, averaging 3.8 grams each, 22.5% total soluble solids, excellent flavor.

18. Picking frame for harvesting grapes from overhead arbor. Fruit can also be placed directly into containers set on frame.

19. Picking frame for harvesting. Berries can be graded and packed as they roll out.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

MUSCADINE GRAPE BREEDING

C. F. Williams

FOREWARD

Three important achievements have resulted from the grape breeding program; (1) new self-fertile selections of muscadine grapes have been originated that are as good as any previous pistillate varieties and better than most, (2) promising tetraploid selections have been developed, (3) a fertile species hybrid with high quality fruit has been produced by hybridization and chromosome doubling. While these developments are important in themselves, their greatest value results from indicating germ plasm and methods of using it whereby progress in the future can be more rapid and certain in each of the above three phases of breeding.

The principle objective of the grape breeding program as reorganized in 1945, was to develop perfect-flowered varieties of high quality and good vine characteristics. Those that had recently been introduced, while very valuable as pollinators, lacked considerably in other characteristics. Selections from the first five years of breeding under the reorganized program, are better than any of the previously named perfect-flowered varieties, but probably not so good as the best named pistillate ones. Selections from the second five year period are as good as most of the present varieties. A break in the program occurred at this stage due to moving all breeding material to Clayton, N. C. In the third five year period, selections were obtained that gave every indication of being better than most of the present named varieties in vigor, resistance, productivity and fruit qualities.

Crosses made since the work was moved to the Central Research Station at Clayton, N. C., using these advanced selections as parents should show even further improvement by recombination of desirable characteristics. Some of these crosses will fruit for the first time in 1961; seeds of other crosses made in 1960 have just been sown.

The development of these new muscadine selections is not an end result in itself. Still more important is the assembling of the germ plasm which provided these selections; germ plasm which has not yet fully expressed itself in any one selection; germ plasm for vigor, productivity and disease resistance of plant, size and non-shattering of cluster, dry scar, size, flavor, sweetness, acidity and texture of berry.

Two tetraploid muscadine grape seedlings fruiting for the first time in 1960 were outstanding in fruit quality, and berry size, and had good vine characteristics. These are very promising selections for testing as future new varieties. They are the first indication of the possibilities from breeding within the species at the tetraploid level. Tetraploid breeding was started in 1954 and indicated little promise at first because of slow and poor habit of growth of most of the seedlings. These new selections indicate the advisability of exploring this type of breeding further. Superior parental stock with known desirable germ plasm is now available and should be polyploidized for use as parents in such crosses. It is probable that true tetraploids as they are developed by breeding will be more useful as parents than the chimeral colchiploids. Many tetraploid seedlings from controlled crosses which have not yet attained fruiting size are growing in the vineyard at present.

The first fruiting in 1960 of a tetraploid species-hybrid is a development of major importance. Such a hybrid has been sought for over 100 years. This is the first species-hybrid with muscadine grapes to have fruit of high quality and indicates that such hybrids are now possible through polyploidy. This selection is good enough on the basis of one year's fruiting to consider testing it as a new variety for introduction if the difficulties of propagation and clonal stability from its being a colchiploid can be overcome. Even so, its chief value may be in its use in breeding and as indicating the possibilities of this type of breeding.

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Many similar species hybrids are now growing in the vineyard at Clayton and should fruit for the first time in the next two years. Continual examination of them will be necessary in 1961 to limit their growth to the buds and shoots polyploidized by colchicine.

By fruiting the first year from seed, this species-hybrid selection has also shown how much time could be saved if more nearly optimum growing conditions could be provided. In general it has taken various diploid seedlings at least 4 years from seed to first selection, and in the process many seedlings have been lost. It has taken 6 years to fruit polyploids from seed.

This report is an outline of the work program by which the above selections were developed. It is divided into three parts, diploid breeding, polyploid breeding, and species hybridization. It is intended to indicate the procedures, the plant material used, the genetic sources of various desirable and undesirable characteristics, and some of the possibilities and problems.

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I DIPLOID BREEDING

Introduction

The muscadine grape program was reorganized in 1945-46 at which time 15 selections from previous breeding by Charles Dearing were named and introduced (3) (Table 1). The most important of these were six perfect-flowered varieties, the first fruitful pollinator varieties available for home or commercial planting. Although these are replacing non-bearing male vines for pollinators, it is doubtful if they can or should replace the best pistillate varieties where more than one vine is planted because they lack characteristics essential to successful varieties. They are inferior in fruit qualities and the best light colored perfect-flowered varieties are subject to foliage disorders caused by black rot fungus and probably by Pierce's virus.

The principal objective of the reorganized breeding program has been to combine self-fertility with high fruit quality and desirable vine characteristics. It has previously been shown that 50% of the seedlings in crosses between pistillate and perfect-flowered parents are perfect-flowered (2,6,10). The use of perfect-flowered parents in breeding also makes possible the use of pollen parents with known fruit characteristics.

Selections developed from three original sources of the perfect-flower character are available for breeding. Two of the original vines were found by Charles Dearing among seedlings being tested in the department vineyards at Willard, N. C. (1). One of these (V23 R4 B2) was from a cross made in Florida probably with a male V. munsoniana; the other (V19 R7 B2) was from a cross made at Enfield, N. C., with a male V. rotundifolia. The third perfect-flowered vine (Hope) was found in the wild by F. C. Reiner at Raleigh N.C. and used in breeding by L. R. Detjen at the N. C. Agricultural College (6). The original hermaphroditic vines have not survived but selections from crosses with each of them are available.

Inheritance Studies

From 1945 to 1960 inclusive, 163 crosses between diploid muscadine grapes have been made as well as many self-pollinations. These are listed in Table 2.

The first stages of the reorganized breeding program consisted of progeny tests of the available perfect-flowered selections by selfing and by crossing with selected pistillate varieties. Inheritance studies of these progenies indicated genetic sources for vigor, productivity, and resistance to leaf spot caused by black rot fungus, size of cluster, persistance of fruit, time of maturity and quality characteristics of sugar, acid and texture of pulp and skin (15).

The selections derived from Hope, (G-52, 25-8-26 and 37-10-1) have produced progenies of average vigor and disease resistance, good cluster, and large berry size, with rather thick skin and high acid but fair to good flavor.

The data shown in Tables 3, 4 and 5 are progeny averages for vigor, resistance, fruit size and sugar of these first crosses. Since these are averages of all seedlings in each cross, they are much lower than similar measurements for selections which would necessarily have had much higher scores to have been selected.

Vigor. Most of the parents used in these muscadine grape crosses have been vigorous, and in general their progenies have had good vigor unless they were severely injured by disease, defoliation or other causes. The relatively low average ratings in the tables are partly due to these data having been taken while the vines were young (1 and 2 years), crowded, and before any seedlings had been discarded for disease, sex, injuries and other causes.

The progenies of Tarheel and of Topsail were very vigorous . Tarheel selections were also productive, resistant to black rot, and had large non-

shattering clusters. Sixteen selections from various Tarheel crosses were used as parents in 35 different crosses. Progenies in these crosses were rated high in vigor, resistance, large cluster and persistence. Selections from these latter crosses have been used as parents in a third set of crosses.

Resistance to black rot. In the first crosses Tarheel seedlings showed the least leaf spotting from black rot fungus and those of Wallace, Willard, and Scuppernong the most, Table 3B. In later crosses the more resistant selections have been used as parents where this was possible considering the other characters desired from the cross. Although ratings made in different years and locations are not entirely comparable it is probably a fair observation that less infection from leaf-spot caused by black rot is presently found in progenies of the more recent crosses, especially when the comparisons are made with established varieties as standards. Probably complete resistance does not occur. However, frequently it has been impossible to find any leaf spot on some selections when adjoining ones were infected. Seedlings in more recent crosses whose parentage included Tarheel have been more resistant to black rot than those with other parentages.

Other diseases. Tarheel is more susceptible to downy mildew than any other muscadine grape observed. This disease reduces fruit setting and causes severe russetting on the berries. Susceptibility was transmitted to Tarheel progenies, especially in the cross Topsail x Tarheel (Cross 11). Following generations are less susceptible indicating that V. rotundifolia in general carries considerable resistance.

Infection from cercospora leaf spot frequently is severe in late summer and during harvest on mature leaves. It may cause severe defoliation. Ratings of varieties and seedlings for this disease have not been consistent. Severity appears to be associated with maturity or condition of foliage which

shattering clusters. Sixteen selections from various Tarheel crosses were used as parents in 36 different crosses. Progenies in these crosses were rated high in vigor, resistance, large cluster and persistence. Selections from these latter crosses have been used as parents in a third set of crosses.

Resistance to black rot. In the first crosses Tarheel seedlings showed the least leaf spotting from black rot fungus and those of Wallace, Willard, and Scuppernong the most, Table [illegible]. In later crosses the more resistant selections have been used as parents where this was possible considering the other characters desired from the cross. Although ratings made in different years and locations are not entirely comparable it is probably a fair observation that less infection from leaf-spot caused by black rot is presently found in progenies of the more recent crosses, especially when the comparisons are made with established varieties as standards. Probably complete resistance does not occur. However, frequently it has been impossible to find any leaf spot on some selections when adjoining ones were infected. Seedlings in more recent crosses whose parentage included Tarheel have been more resistant to black rot than those with other parentages.

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Infection from [illegible] leaf spot frequently is severe in late summer and during harvest on mature leaves. It may cause severe defoliation. [illegible]

[illegible]

probably is related to environmental conditions. It may appear to be more severe at any one date on some varieties and selections than on others, while at a later date the situation may be reversed or confused by defoliation.

Pierce's disease. Little can be added to the information concerning resistance, tolerance or immunity to the virus of Pierce's disease. Except possibly for the extremes at each end of the scale, clear cut symptoms have not been evident to this observer. Most of the successful older varieties must be fairly tolerant. However, infection may be the cause of low yields as on Scuppernong and for very variable annual yields and vigor. Partial occlusion of the conducting vessels might account for the severe effects of unfavorable environmental conditions on infected plants.

Infection appears to be more rapid and severe in some populations of seedlings than in others, indicating genes for resistance or susceptibility to the disease or to its vectors. Propagations of some selections have declined very rapidly when planted in a different location than that of the original plant. If the occurrence of the virus is as common and wide spread as is supposed, rougeing or eradication of infected plants will probably be of little advantage. Since differences occur among seedlings and seedling populations, considerable promise does exist for developing more resistant sorts. This would be more rapid of definite determinations of infection could be made. It is possible that other viruses may complicate the situation.

Berry size has been determined by weight of a sample usually of ten berries. This measurement was taken annually of all varieties and selections and, until 1957, of representative samples (100 vines) of most progenies. Average berry sizes of progenies in most of these first crosses shown in Tables 3C, 4 and 5 were small, between 3.0 and 3.5 grams.

Although the berries of the variety [illegible]scheel are smaller than those of the other varieties used as parents, and those of its progeny from self-pollination were extremely small (1.8[illegible] grams), the average size of the fruits of its progenies when crossed with other varieties was no smaller than that in other crosses.

Berries of Topsail seedlings (Table 30) were above 4 grams in [illegible]. Three selections from Lucida crosses (NC 27-[illegible], NC [illegible]-[illegible] and NC 28-222) one from Topsail (NC 00-60) and the variety Topsail transmitted berry size to their progenies in the next series of crosses. Of 106 selections in the seedling vineyard in 1960, 18 had an average berry size of 7 grams or [illegible]. Fourteen of these had either Topsail or Lucida parentage and 3 of the others were pistillate selections.

The fact that only perfect-flowered vines were saved from the crosses made in 1946-1947 and 1948 may account for the slight difference in berry size between crosses and for the generally small size in those crosses [illegible]. Both the perfect-flowered and pistillate vines were fruited [illegible] 13 of the crosses made in 1949-1950-1951. In each o[illegible] these crosses the berries of the pistillate vines were larger than those of perfect-flowered vines, the average increase in size being [illegible] (Tables 6 and 7). The larger berry size of pistillate vines was not due to their being less productive or having more seeds per berry than those of the perfect-flowered vines ([illegible]). This would indicate a linkage of berry size with [illegible]. However, in crosses where Lucida was one parent, the average berry size of both pistillate and perfect-flowered vines was large with an increase of only [illegible] in relation to the pistillate flower type. This would suggest an absence of linkage in Lucida (Table 6). A comparison of berry size when different pollen parents were crossed on Scuppernong, NC [illegible] - [illegible] and Thomas indicate that

Although the berries of the variety Tarheel are smaller than those of the other varieties used as parents, and those of its progeny from self-pollination were extremely small (1.89 grams), the average size of the fruits of its progenies when crossed with other varieties was no smaller than that in other crosses.

Berries of Topsail seedlings (Table 3C) were above 4 grams in size. Three selections from Lucida crosses (NC 27-229, NC 28-193 and NC 28-222) one from Topsail (NC 60-60) and the variety Topsail transmitted berry size to their progenies in the next series of crosses. Of 106 selections in the seedling vineyard in 1960, 18 had an average berry size of 7 grams or over. Fourteen of these had either Topsial or Lucida parentage and 3 of the others were pistillate selections.

The fact that only perfect-flowered vines were saved from the crosses made in 1946-1947 and 1948 may account for the slight difference in berry size between crosses and for the generally small size in these crosses (8). Both the perfect-flowered and pistillate vines were fruited in 13 of the crosses made in 1949-1950-1951. In each of these crosses the berries of the pistillate vines were larger than those of perfect-flowered vines, the average increase in size being 17.8% (Tables 6 and 7). The larger berry size of pistillate vines was not due to their being less productive or having more seeds per berry than those of the perfect-flowered vines (16). This would indicate a linkage of berry size with sex. However, in crosses where Lucida was one parent, the average berry size of both pistillate and perfect-flowered vines was large with an increase of only 1.8% in relation to the pistillate flower type. This would suggest an absence of linkage in Lucida (Table 6). A comparison of berry size when different pollen parents were crossed on Scuppernong, NC 25-8-26 and Thomas indicate that

NC 11-173 as pollen parent transmitted genes for berry size (Table 7). The possibility that the larger size berries of pistillate vines is due to a hormone stimulation from cross pollination, with an absence of such stimulation in self-fertile vines was neither proved nor disproved because of the difficulty of preventing self-pollination of perfect-flowered vines without injury to the flowers or pistils by emasculation.

Sugar was determined as total soluble solids with a hand refractometer. Measurements have been taken annually of all selections and varieties, and until 1957 of representative samples (about 100 vines) of most progenies from the first 71 crosses.

Latham, and its seedlings Topsail and V21 R15 B2 from previous breeding, are high in sugar and flavor. Progenies in crosses with one of these as a parent were high in sugar (Tables 3D and 4). Many selections from these crosses had refractometer readings of 22 and 25%, and one seedling had a reading of 32.5%. When several of these selections were used as parents in crosses, the resulting seedlings were high in sugar and flavor. The variety Thomas probably has contributed to the sugar in some of the progenies, by itself and through its seedling Burgaw. In contrast to this, progenies of Wallace, Duplin, Lucida, and Cape Fear were low in sugar, unless the other parent had relatively high sugar.

Acidity has been determined only by taste. It is a more important quality than this would indicate. A method of measurement for use in the field as simple to use as the hand refractometer for sugar would be valuable. In these crosses the acidity of Duplin and its progenies was especially sharp. The acidity in Hope progenies was high but not as pronounced because sugar was higher in these crosses than in crosses with Duplin. The fruit of Wallace and Lucida seedlings seemed acid in flavor, probably

NC 11-173 as pollen parent transmitted genes for berry size (Table [illegible]). The possibility that the larger size berries of pistillate vines is due to a hormone stimulation from cross pollination, with an absence of such stimulation in self-fertile vines has neither proved nor disproved because of the difficulty of preventing self-pollination of perfect-flowered vines without injury to the flowers or pistils by emasculation.

Sugar was determined as total soluble solids with a hand refractometer. Measurements have been taken annually of all selections and varieties, and until 1957 of representative samples (about 100 vines) of most progenies from the first 71 crosses.

Latham, and its seedlings Topsail and V21 R15 B2 from previous breeding, are high in sugar and flavor. Progenies in crosses with one of these as a parent were high in sugar (Tables 30 and [illegible]). Many selections from these crosses had refractometer readings of 22 and 25%, and one seedling had a reading of 27.5%. When several of these selections were used as parents in crosses, the resulting seedlings were high in sugar and flavor. The variety Thomas probably has contributed to the sugar in some of the progenies, by itself and through its seedling Yuga. In contrast to this, progenies of Wallace, Dulcet, Lucida, and Cape Fear were low in sugar, unless the other parent had relatively high sugar.

Acidity has been determined only by taste. It is a more important quality than this would indicate. A method of measurement for use in the field as simple to use as the hand refractometer for sugar would be valuable. In these crosses the acidity of Duplin and its progenies was especially sharp. The acidity in Hope progenies was high but not as pronounced because sugar was higher in these crosses than in crosses with Duplin. The

[illegible]

because it was usually associated with low sugar. There is a need for selections with some degree of acidity in the breeding program, at least for the processing market. Selections for breeding from Duplin crosses have been saved and used for this purpose. The acidity can and should have a pleasing flavor.

Flavors, especially desirable ones, are probably olifactory and aromatic due to very minor amounts of esters and alcohols. Strong pleasing grape flavors are found in Latham, Thomas, Creswell, and V21 R15 B2. Seedlings of these parents were generally well flavored. In contrast, Cape Fear and Tarheel have distinct varietal flavors which are flat and undesirable. These may be due to their being low in aromatic compounds and sugar. This quality is transmitted to their progenies. Lucida has a less pronounced unpleasant flavor which is found in some of its seedlings. A personal observation would be that many of the other varieties used as parents lacked any particular flavor other than sweetness or acidity, and therefore they had little to contribute in the way of flavor qualities. The strong musky flavor that is characteristic of many muscadine grapes (but not confined to this species) was rarely pronounced in any of the progenies in this breeding program.

Productivity ratings of seedlings have been taken for most of the progenies in the breeding program. Averages for seedling populations must be calculated from data taken before any discarding has been practiced during the first year of fruiting while the vines are severely crowded. They are therefore very low and of slight value and are not presented in this report. Low productivity has generally not been a problem of selections after they were of sufficient age (4 or 5 years). In 1960 most of the selections being tested in the overhead vineyard had yields of 50 lbs. or over, and several had yields of over 100 lbs. (10 lbs. per vine = 1 ton

[illegible] cause it was used [illegible] compared with low [illegible]. There is a [illegible] selection with some degree of acidity in the breeding program [illegible] the processing [illegible] selections for [illegible] or used [illegible] been saved and used [illegible] purpose. The acidity [illegible] should also [illegible] pleasing [illegible].

Flavor. [illegible] desirable ones, are [illegible] of factors [illegible] due to very other amounts of [illegible] sugars and alcohol. Strong [illegible] flavors are found in [illegible] Thomas, [illegible] and [illegible]. [illegible] These parents were generally [illegible] flavored. In contrast, [illegible] Tomatoes have distinct varietal flavors which are flat and [illegible]. These may be due to their being low [illegible] compounds and [illegible] quality [illegible] transmitted to [illegible] progeny [illegible] less [illegible] unpleasant flavor which [illegible] found in some of its seedlings. [illegible] would be that many of the [illegible] varieties used [illegible] lacked any particular flavor other than sweetness or acidity, and therefore [illegible] had little to contribute in the way of flavor [illegible]. The strong [illegible] flavor that [illegible] of [illegible] (not confined to [illegible] species) was [illegible] of the progenies in this breeding program.

[illegible] have been taken for most of [illegible] [illegible] popularity [illegible] [illegible] [illegible] [illegible] [illegible]

per acre). In the breeding program where low productivity has occurred, it probably has been due to factors other than inherited capability. Very high productivity has been found in some crosses. Large cluster size frequently is associated with high productivity. Thus Tarheel as a parent has given productivity in crosses, and F_1 selections of Tarheel when used as parents in crosses have produced very productive seedlings.

Cluster. Large cluster size is characteristic of Tarheel, Duplin and their progenies, and has been transmitted through three generations. It also appears in other progenies, notably some of those derived from Hope. Evenness in time of bloom probably increases percent of fruit-set within the cluster and contributes to cluster size and to its compactness. To be satisfactory the cluster should not be too compact and a large frame-work is needed as well as a long cluster-stem to facillitate picking. Compactness is also affected by berry size. Shape of cluster is variable from broad, with or without a distinct shoulder to cylindrical. All these characteristics are found in the breeding material and have been selected.

Persistance of fruit or non-shattering of cluster is especially important if the fruit is to be harvested in clusters. In any case, berries need to hang on the vine until harvested. On the other hand if berries are to be harvested loose with a dry scar like plums, extreme persistance causes tearing of the skin, pulling the brush out of the berry, and broken skin from too much pinching. All of these factors result in wet, poor quality fruit which deteriorates rapidly. Loose fruit with dry scar can be harvested rapidly and graded and packaged readily. It is ideal and probably necessary for mechanical harvesting. These are characteristics desired in other grape regions, which muscadine grapes already have naturally. Both types of varieties probably have a place on the market and have been selected.

Shelling of berries is associated with and aggravated by uneven ripening. In this, muscadine grapes are no different than other genera, very few of which mature all of their fruits on the same date.

Even ripening within the cluster is essential for cluster harvesting and uniform ripening of a variety is important for commercial harvesting by any method. Some of the named varieties like Scuppernong, Thomas and Topsail are very uneven in ripening. This is probably the principle reason for their shattering so badly before and during harvest. Some varieties like Hunt ripen more evenly and persist well enough so that they can be harvested in one picking for the processing market. Many of the present selections from the breeding program ripen very uniformly and can be harvested in one picking. None ripen evenly enough for all of the berries to be top quality for the fresh fruit market with one picking, but with some selections 80 to 90% of the fruit is satisfactory at one time. This characteristic of even-ripening has not been associated with any particular parentage, but has been found in all breeding lines. It is least in progenies of Scuppernong and Topsail.

Soft pulp. Fruit with very soft or melting pulp occurred in seedlings from self-pollination of Duplin. This should be a valuable fruit character for processing for juice. Duplin was used as one parent in crosses with Latham, Topsail and Hunt, and transmitted this characteristic in some degree to many of its seedlings. A high percentage of them had softer than average pulp but very few had completely melting flesh in which most of the pulp disappears. Duplin also transmitts high acidity.

Sex. The progenies from self-pollination of the original hermaphroditic selections, differ in the inheritance of the three flower types (pistillate, staminate and functional hermaphroditic) (11). Those from "Hope" and V19 R7 B2 include seedlings of each of the three flower types. Similar progenies

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] similar progenies

from V23 R4 B2 include only seedlings with pistillate or hermaphroditic flowers and none with staminate flowers. One parent of V23 R4 B2 was V. munsoniana while both parents of V19 R7 B2 were V. rotundifolia which may account for the difference in the mode of inheritance. On this basis it is presumed that both parents of Hope were V. rotundifolia. No clones that were homozygous for perfect-flower type were found until recently when Loomis identified one selection M 36-2A as such. (12) Two seedlings M 44-8C and M 45-9C resulting from self-pollination of M 36-2A also are homozygous for perfect-flower. The small berry size associated with perfect-flower type may result in especially small berries on vines which are homozygous for this character and thus act as a selection index against their being tested or used in breeding.

One of 83 seedlings resulting from self-pollination of Burgaw had staminate flowers on the main part of the vine. This vine developed a branch of normal vigor which for five years bore functional hermaphroditic flowers which set fruit from self-pollination. This would suggest that in this breeding line from V19 R7 B2 that the characteristic of perfect-flower originated as a mutation from the staminate form.

This mutation was lost when the breeding stock was moved from McCullers to Clayton, N. C. The top of the vine died back to a point below the origin of the mutation. It is probable that other similar chimeral plants have been lost during the elimination of male vines at the time of bloom. Only when male vines were found in progenies where they were not expected were they carefully examined and not always there when the work was performed by student labor.

Progenies from self-pollination

Populations from self-pollination of perfect-flowered vines have been

grown. These include the 6 named varieties and 8 numbered selections from Dearing's breeding work at Willard, N. C., 30 of the selections grown at McCullers, and two derived from Hope. The vigor of these progenies was reduced but in most cases not extremely so. That of Tarheel and Duplin seedlings was good.

The berry sizes of selfed progeny of all of the Willard selections except Duplin, were very small, some progenies having berries not more than 1/4 to 3/8 inches in diameter. This small fruit size was found for all the progenies from selfing the selections at McCullers which were derived from the Willard material, except N. C. 11-173, some of the seedlings of which had fair sized fruit. Seedlings from selfing N.C. 25-8-26 and N.C. 37-10-1 (from Hope) also had fruit of fair size.

Seedlings of Duplin x self had very soft and melting pulp. Some of these were the only S_1 selections used as parents in breeding and are the only such S_1 selections (pure muscadine) in the breeding stock at present (Jan. 1, 1961.)

A summary of the source of various characteristics is given in Tables 8 and 9.

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Selections

The first crosses of the reorganized breeding program starting in 1946 and using the perfect-flowered varieties then available as the source of this character, produced perfect-flowered selections that were better in fruit and plant characters than their parents. Although they were not better than the good pistillate varieties, they have been tested as rapidly as possible for use as better quality pollinator varieties. Fifteen of these selections were sent to Experiment Stations in the southeastern states for testing, Table 10. At present, January 1961, five selections are sufficiently promising for release, NC 27-262, NC 29-193, NC 9-305, NC 59-32 and NC 60-60, although the last three have been tested only in North Carolina.

Two other selections should be given consideration for release as very early sorts of good quality ripening in late August, NC 15-229 (black) and NC 115-180 (light). These were discounted for shelling in preliminary testing as their fruit was past its prime by September 1 when other seedlings and selections were beginning to ripen.

Ten other of the older selections are still under consideration. The first four have performed well in Georgia and Mississippi and the last six appear better than these in North Carolina but have not been tested elsewhere; NC 11-173, NC 11-186, NC 27-128, NC 33-13, and NC 29-32, NC 29-115, NC 29-156, NC 33-98, NC 44-15, NC 57-56.

Selections originated in crosses in which some of the first selections were used at the source of the perfect-flower characters indicate further improvement and several appear to be as good as most of the pistillate varieties so that their use would not be limited to pollination purposes. Preliminary tests of these for possible release were interrupted by moving Research Stations. In recent years pistillate vines have been selected in many promising crosses chiefly for use as seed parents in further crosses. This has made possible more combinations and larger populations with both parents from

advanced breeding without the difficulties and restrictions from emasculation. Seedlings from such crosses are now fruiting and have produced selections that promise to be superior in fruit and vine characteristics to anything previously developed. These should be tested as rapidly as possible.

All present selections are classified in the inventory of grape material in Table 24, (1C and 2A) according to their evaluation with brief notes as to their chief characteristics. Of 54 selections originated at McCullers and moved to Clayton, 33 now remain, some of which are of value principally as breeding stock.

A few of the selections discarded at Clayton after 1960 still remain in the testing vineyards at Willard and Jackson Springs. These should be replaced by newer, better selections as propagations become available as has been done at Clayton.

In general, selections from this breeding program have been more productive than most of the older varieties. The most satisfactory and comparable yield records have been secured at Clayton, N. C., Table 11. These vines were planted in the spring of 1956. They bore a little fruit in 1958 and were hardly in full bearing in 1960. However, at that time many of the selections bore yields of a bushel of fruit per vine (50 lbs.) and several bore twice this amount.

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All present selections are classified in the inventory of grape material in Table 24. (10 and 24) according to their evaluation with brief notes as to their chief characteristics. Of 54 selections originated at McCullers and moved to Clayton, 33 now remain, some of which are of value principally as breeding stock.

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II POLYPLOID BREEDING

Colchiploids

The first recorded tetraploid muscadine grapes were those originated by Dermen with colchicine in 1953 (4). He was successful in treatments of 16 varieties and selections, and in following years induced tetraploidy in 5 other varieties, Table 12. These were planted in North Carolina in 1954 and bloomed for the first time that year.

From two to five polyploidized plants of each of the 21 clones have been grown and observed as well as rooted propagations of several of them. Some of the propagations have been sent to other locations for observation (Table 13).

In order to have satisfactory measurements of the effect of tetraploidy on vigor, productivity, disease, etc., it would be necessary to grow propagations of the diploid and colchiploid forms of the same clones, that were comparable in age, condition and environment. Such a test was attempted with two-plant plots of both forms of 13 varieties. After four years the test was discontinued because of the failure of either the diploid or the tetraploid vines of several of the clones to become established.

Growth. The selections have reacted differently to induced polyploidy in growth as shown in Table 12, but all of the vines of each clone have reacted similarly, indicating that differences are due to a clonal (not individual) response. Nine of the colchiploids have been rated as very vigorous and 5 of them as normal in vigor. Three of the clones, Topsail, Yuga, and M 14-5A have been less vigorous than diploids should have been and have had poor foliage with necrotic areas (flecking). These responses are not believed to be due to colchicine treatment but to be caused by disease, although the symptoms may have been intensified by the treatments.

Four clones, Scuppernong, Dulcet, NC 17-197 and M10, were very much stunted and dwarfed. Terminal buds on the shoots of these plants developed soon after the initiation of spring growth causing a cessation of length growth. Total annual length growth of shoots sometimes amounted to only a few inches. Leaves of the dwarfed plants were smaller than normal but were dark green and no more susceptible to foliage disorders than those of diploid forms of the same clones. Gibberellin sprays applied (1) as buds were breaking, (2) on tender new shoots, (3) about one month later failed to overcome the dwarfing.

Other growth responses to tetraploidy are similar to those reported for other species; shorter thicker internodes, generally more acutely angled nodes, rougher bark, thicker leaves, larger buds, especially flower buds. Stomatal measurements showed a length of 27-29 microns vs 19-24 for diploids. Stomatal size was somewhat variable and in any case indicated only the ploidy of external layer. Such measurements might be helpful with seedlings to establish a difference between diploid and tetraploid plants but did not identify triploids because of overlapping ranges in size. Dry pollen grains of tetraploids had a length of 33-39 microns vs 27-31 for diploids. When pollen is available, its size should distinguish between diploids and tetraploids. Pollen samples of colchiploids contained many abnormal grains and a lot of "trash" - in comparison with samples of comparable diploid clones. Germination in sugar solution frequently was as low as 1 or 2%. A cytological study of mitosis might explain the reasons for the low yields of viable seeds in some crosses, and aid in selection of parents, especially when colchiploid plants are to be used.

Productivity of the original colchiploids has been variable but was rated as satisfactory or better for most of those that were vigorous.

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NC 20-30 has been especially productive. Production of the varieties that were dwarfed was relative to their size capacity. Topsail has had almost no fruit, Dallas has had none (very subject to black rot), M6-4A and Hunt have borne very little fruit. Possibly in general the pistillate varieties have been less productive than the perfect-flowered ones, although the two forms have been interplanted to insure cross-pollination.

Berries. Berries ripened earlier on tetraploid vines than on diploid vines of the same variety. This difference in time of maturity was small for early ripening and mid season varieties (3-5 days) and greatest for late varieties like Creek and Higgins. Tetraploid Higgins ripened 30 days before that of the diploid vines. No differences were found in total soluble solids by refractometer measurements or in flavors by tasting. No differences were recorded for texture of pulp or skin.

The conspicuous difference between diploid and tetraploid vines was in size of berry as shown in Table 14. This increase in size was variable but generally was about 30% by weight. It was least for NC 17-197, a selection which was much dwarfed from the colchicine treatment. Selection M10 and Scuppernong were as severely dwarfed as NC 17-197 yet the berries of these were considerably larger than those of the diploid vines.

The increase in berry size was not due to greater fertility or a larger number of seed per berry. Tetraploid berries had fewer seeds and were larger than diploid berries containing the same number of seeds, Table 14.

Scatter-grams of size of berry in relation to number of seeds for NC 11-178, NC 20-30, M7 and M10, are shown in Figures 1, 2, 3 and 4. Data for several of the other colchiploids showed similar distributions. Seeds of tetraploid berries were larger than those of diploid berries of the same selection.

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Quality. Berries ripened earlier on tetraploid vines than on diploid vines of the same variety. This difference in time of maturity was small for early ripening and mid season varieties (3-5 days) and greatest for late varieties like Creek and Higgins. Tetraploid Higgins ripened 30 days before that of the diploid vines. No differences were found in total soluble solids by refractometer measurements or in flavors by tasting. No differences were recorded for texture of pulp or skin.

The principal difference between diploid and tetraploid vines was in size of berry as shown in Table 14. This increase in size was variable but generally was about 30% by weight. It was least for NC 1[illegible]-1[illegible], a selection which was much dwarfed from the colchicine treatment. Selection M10 and Scuppernong were as severely dwarfed as NC 1[illegible]-1[illegible] yet the berries of these were considerably larger than those of the diploid vines.

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[illegible] of size of [illegible] [illegible] [illegible]

[illegible], [illegible] - , M7 and M10, are shown in Figures [illegible], [illegible], [illegible] and [illegible]. Data [illegible] other colchiploids showed similar distributions. Seeds [illegible] than those of diploid berries of the [illegible].

Propagation. These colchiploid plants have been more difficult to propagate than the diploid vines of the same clone. This was especially true when using dormant cuttings. Aerial layers and soft-wood cuttings developed roots but generally failed to develop new shoot growth and become established. This was pronounced for propagations of those colchiploids that showed dwarfing like Scuppernong, or were weak like Topsail.

Propagations of 4x 20-30 were planted in the test vineyards at Clayton, Willard and Jackson Springs. Growth, yield, and quality of fruit at Clayton were very good. This tetraploid selection appeared to be sufficiently promising to be tested for possible release as a new variety. In 1959, a propagation test was made using 600 soft-wood cuttings in various treatments. Similar tests were conducted with diploid Thomas. Average rooting of both varieties was 91%, however, only 14% of the rooted cuttings of 4x 20-30 produced shoot growth while 51% of the 2n Thomas did so. Of the cuttings lined out in the nursery in 1960, 56% of each kind survived but the plants of NC 4x 20-30 made an average growth of only two feet in comparison with four feet for the Thomas plants. The plants of 4x NC 20-30 were very variable in vigor, many being very weak.

Propagations of many of the other colchiploids have been slow growing, stunted or difficult to get established, even those of which the original colchiploid has been vigorous. Many of these propagations have had poor stunted root systems. It would appear that polyploid tissue produces poor roots and in the colchiploids, the vigor of the root and plant may vary with the proportion of polyploid tissue involved.

Breeding

Tetraploids. Crosses between tetraploids have been less successful

than similar diploid crosses, fewer seed have been obtained, germination has been low, growth of seedlings has been poor and slow, and survival has been poor. No seed were obtained from self-pollination in 1954, the first year the colchiploids were set in the field. This may have been due to severe 2-4-D injury which occurred at the time of full bloom. Seeds from open pollination were saved and grown. Those from the named varieties must have resulted from natural crossing since these varieties are pistillate. All the numbered selections are perfect-flowered and most of the seed of these may be from self-pollination but not necessarily so.

The lower germination of seed, and survival of seedlings and the slower growth of tetraploid seedlings are shown in Table 15. Some of the poor growth has been due to their inferior and stunted root systems which resembled the damage from sting nematodes in their short bunchy appearance, yet this condition was found when potting seedlings germinated in sterilized soil. With these poor roots many of the seedlings failed to get established in the nursery and either died or made only a few inches of growth. Many of these small plants were discarded after two or three years since they showed no indication of attaining fruiting size. In Table 16, the numbers of surviving plants are low, partly because of this elimination. The remaining seedlings were slow in beginning to bear fruit. It is possible that growth and fruitfulness of these was delayed until the slow growing roots reached better soil at lower depths (They were grown in a sandy location with a clay subsoil).

The top growth of many of the tetraploid seedlings has been dwarfed with short nodes and small leaves, and frequent formation of terminal buds. Others have had fair vigor and relatively large diameter canes. Attempts were made to overcome this dwarfing with sprays of gibberellin in 1957.

Sprays were applied to arms on vines of the four colchiploid varieties that showed dwarfing and also to dwarfed tetraploid seedlings and to normal diploid plants. Treatments were made before and after buds started, when shoot growth had started and about one month later. No differences were observed as a result of these treatments.

By the end of 1959, only the more vigorous seedlings remained from the seed saved in 1954 and 1955. None had shown any promise over diploid plants even in berry size. In 1960, the seedlings of 4x Creek x open pollination set fruit and one of them, C72, ripened in late August, at least 6 weeks earlier than the diploid Creek variety. These berries were large, attractive and of excellent flavor and quality. Some of the other 4x Creek seedlings ripened in early September and had fruit of desirable size and quality.

These 4x Creek seedlings are the first of the muscadine tetraploids that have shown any promise. Two of these on the basis of 1 year of fruiting were suitable to consider for new varieties if they prove to be sufficiently productive and vigorous. It is possible that the true or fully tetraploid plants may be more usable in breeding and culture than the chimeral colchiploid ones; ie. they may propagate more easily and the micro- and megaspores may be more normal. For this reason several other tetraploid selections were saved from other crosses and selfings for testing and to use in breeding. These other tetraploid selections are good in every respect but no better than similar diploid ones. Their present value is for use in breeding, and for comparison with colchiploid plants.

The above tetraploid selections originated from seed saved at the McCullers Research Station. Seedlings from crosses made at the Clayton Research Station are presently growing in the field (Table 16). Only two

[illegible] were [illegible] ied to arms on vines of the four colchiploid varieties [illegible] showed dwarfing and also to dwarfed tetraploid seedlings and to normal diploid plants. Treatments were made before and after buds started, when shoot growth had started and about one month later. No differences were observed as a result of these treatments.

By the end of 1959, only the more vigorous seedlings remained from the seed saved in 1954 and [illegible]. [illegible] one had shown any promise over diploid plants even in berry size. In 1960, the seedlings of 4x Creek x open pollination set fruit and one of them, 672, ripened [illegible] late August, at least 6 weeks earlier than the diploid Creek variety. These berries were large, attractive and of excellent flavor and quality. Some of the other 4x Creek seedlings ripened in early September and had fruit of desirable size and quality.

These 4x Creek seedlings are the first of the autoploid tetraploids that have shown any promise. Two of these on the basis of 1 year of fruiting were suitable to consider for new varieties if they prove to be sufficiently productive and vigorous. It is possible that the true or fully tetraploid plants may be more useful in breeding and culture than the chimeral colchiploid types; i.e. they may propagate more easily and the micro-[illegible] [illegible]es may be more normal. For this reason several other tetraploid selections were saved from other crosses and selfings for testing [illegible] [illegible] [illegible]eding. These other tetraploid selections are good in [illegible] [illegible] [illegible] no better than similar diploid [illegible]. Their present value is for use in breeding, and for comparison with colchiploid plants.

[illegible] [illegible] [illegible]tetraploid sel[illegible]ions originated from seed saved at the [illegible] [illegible] [illegible]. [illegible] [illegible]ings from crosses made at the [illegible]aytor [illegible] [illegible] [illegible] growing in the field (Table 16). Only two

or three seedlings have fruited, and these have had large fine berries. These tetraploid seedlings are from controlled crosses and should be of special interest in view of the performance of the Creek seedlings which resulted from open-pollination.

Triploids. Several crosses have been made in order to develop triploid plants. The reasons for these crosses were as follows. (1) could this type cross be made, (2) would the progeny be sterile and set seedless fruit, (3) would the progeny have the vigor usually associated with triploidy, (4) would doubling the chromosomes recover full fertility and retain the vigor of the triploid, (5) would the progeny exhibit genome dominance that might be used in breeding?

Most of the crosses were unsuccessful. In those completed, germination was poor and most of the surviving seedlings proved either to be not of the cross or diploid. No triploids were identified by chromosome count among the seedlings from open pollination of pistillate tetraploids. Only one triploid from the first crosses made, has been identified by chromosome count (NC 134-8). This vine, although of normal vigor, has set only an occasional berry of fair size and containing one or two seeds. Propagations of this triploid have been treated with colchicine. Two showed some indication in foliage of having been made hexaploid and are now growing in the vineyard at Clayton.

In 1959, sixteen crosses were made between tetraploid and diploid muscadines and 45 seedlings were grown (Table 16). These seedlings were treated with colchicine in 1960 and 7 were marked as having been doubled and 8 more as possibly being doubled. These are now in the Clayton vineyard.

The plants found to be hexaploid by cytological examination, have had deformed leaves, broad at the base and somewhat fan shaped, and veins

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[illegible]

[illegible]

have been thickened. Whether these deleterious effects will occur with all hexaploids, indicating the limit of ploidy, has not been determined. It is hoped that some normal appearing hexaploids will be found among this lot of seedlings when growth starts in the spring of 1961.

Conclusions. Only generalized conclusions can be drawn from the relatively limited use of these colchiploids as parents in crosses. However, they appear to differ among themselves in performance as parents more than similar diploid clones. Those classified as weak or dwarf in Table 12 have yielded few viable seed and their seedlings have been weaker than those of clones classified as vigorous. To date Creek and NC 20-30 have produced the most vigorous tetraploid seedlings.

When the colchicine treatments were made in 1954, the numbered clones selected were the best of which 10 propagations each were available for treatment. Even at that date there were more promising selections although the performance of any of them as parents was still unknown. Since then better selections (at the diploid level) have been found, some of which have produced promising progenies. Because some of the tetraploid seedlings appeared very promising in 1960, tetraploidy should be induced in the best of these newer selections, and various breeding combinations should be tried at the tetraploid level. It would be desirable to make those crosses that have been most promising at the diploid level. It would also be desirable to polyploidize some of the pistillate selections for seed parents in order to avoid the necessity of emasculation.

III. HYBRIDIZATION WITH AMERICAN AND VINIFERA BUNCH GRAPES.

Muscadine grapes from Vitis rotundifolia are very resistant to most of the insect and disease troubles of other grapes. They are also very vigorous and productive. The berries are large, and well flavored in the improved varieties. Although the fruit clusters are generally smaller and more easily shattered than in other grapes, these could be characteristics of great importance for mechanical harvesting.

The desirability of obtaining hybrids between muscadine and bunch grapes has been recognized for over 100 years. Dr. Peter Wylie apparently was successful in obtaining a few hybrid seedlings about 1870 but these were lost. T. V. Munson believed he had obtained some hybrids from open pollinated seed of Scuppernong about 1900, but these are now known not to be species-hybrids.

Charles Dearing (1) obtained several true hybrids with vinifera and bunch grapes using V. rotundifolia as the seed parent. L. R. Detjen (7) and C. F. Williams (4) between 1912-1925 attempted crosses of V. rotundifolia with 15 species of Vitis and 11 species-hybrid varieties of Euvitis grapes. (Table 17). They obtained 2523 seed in crosses with 7 Euvitis species and with 6 varieties of Euvitis hybrids using V. rotundifolia as the male parent from which 353 seedlings were grown. Only four of the reciprocal crosses were successful from which 22 seed were obtained which produced 7 seedlings. Descriptions of only a few of these hybrids have been published but most of them were identified as true hybrids (8).

N. H. Loomis also obtained several hybrid seedlings from crosses between bunch grapes and V. rotundifolia but only when V. rotundifolia was used as the pollen parent.

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Many of the hybrid seedlings in the above species-crosses by Detjen and Williams, were staminate and the rest were almost completely sterile. No seed were obtained from self-pollination of the F_1 hybrids and only one seed from sib-crosses (Table 18). A few seed were obtained in back-crosses from which 8 seedlings were grown; 6 in back crosses to V. rotundifolia and 2 to V. vinifera. A few of the F_1 hybrids occasionally set a few berries from open-pollination and 85 seed obtained in this manner produced 5 plants. These were probably back-crosses to V. rotundifolia because of pollen availability. All these second generation plants were weak; most of them dying the first year and none reaching flowering age.

The following F_1 clones, from this species-hybridization between 1910-1930, are now growing at the N. C. Experiment Station (1960).

NC 6-15	Malaga x V. rotundifolia
NC 6-16	Malaga x V. rotundifolia
B 4-5	Scuppernong x Louisiana

<u>Progenies of NC 6-15 and NC 6-16</u>. Propagations of NC 6-15 and NC 6-16 were made available in 1938 to R. L. Farrer, a private grape breeder in Atlanta, Georgia. In 1960 he reported that in 1941, 1944 and 1945 he had grown 20 seedlings with NC 6-15 as the pistillate parent (9). It is not clear whether all were the result of crosses with bunch grape pollen, but some controlled crosses with Euvitis varieties were attempted. Of the 20 seedlings grown, 7 were intermediate in appearance, the rest were more like V. rotundifolia although he knew of no available V. rotundifolia pollen. One (F21) resulted from a cross with V. cinerea. Only 6 plants were pistillate and one was perfect-flowered. All were described as normal in vigor. Some of these plants bore a few berries in some years. Plants from these open-pollinated berries were vigorous but unproductive and lacking in quality. Robert Dunstan, a private breeder in Greensboro, N. C., obtained a fertile hybrid (DRX 55) from open-pollination of NC 6-15, probably a back-cross with Euvitis. From

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this fertile hybrid he has grown 300 seedlings from crosses with Euvitis varieties. He has other seedlings from crosses of NC 6-15 x bunch grape. Many of the seedlings in these Dunstan crosses are vigorous and more disease resistant than adjacent Euvitis seedlings. Several are fertile.

In Raleigh, NC 6-15 (2n) has set fruit only occasionally. In 1954 several berries developed from open-pollination, probably with V. rotundifolia (Table 19). From these berries, 52 sound (non-floating) seed were saved of which 24 germinated. Only 12 seedlings were planted in the field. Seven of these have survived and have fair vigor. Seeds from open-pollination of 5 of these were saved in 1959 (probably x V. rotundifolia). At present 200 seedlings are in the nursery at Clayton, N. C.

In 1960, crosses were attempted between these open-pollinated seedlings of NC 6-15 (2n) and Euvitis varieties, muscadine selections, sibs and selfs. Seed were obtained in the crosses with muscadine pollen, one vine set seed in a sib-cross and one vine set seed with self-pollination (Table 19).

No berries have set on NC 6-15 (2n) since 1954. The plants were badly injured by a late freeze in 1955 and moved to the new Research Station at Clayton, N. C. in 1956. The canes were killed back by cold in 1958 and 1959. In 1960, two vines bore a small crop of flowers but no berries developed from crosses with Euvitis or muscadine pollen, or from open-pollination.

Dermen induced fertility in the partially sterile NC 6-15 and sterile NC 6-16 by chromosome doubling with colchicine (5). He obtained seed from open pollination of NC 6-15 (4x) and from the pollination of NC 6-15 (4x) x NC 6-16 (4x) (Table 20). At Raleigh in 1960, seed were obtained by selfing NC 6-16 (4x) but not NC 6-15 (4x). NC 6-15 (4x) set seed when pollinated by NC 6-16 (4x), and both set seed when pollinated by Champanel (4x) and by U.S. 520-2 (4x). Pollination with pollen of tetraploid varieties of V. rotundifolia was not tried but the reciprocal cross Creek (4x) x NC 6-16 (4x) was unsuccessful.

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129 seedlings from open-pollination of NC 6-15 (4x) showed little variability in growth or leaf characteristics in 1960 after a year in the vineyard. Seven seedlings from NC 6-15 (4x) x NC 6-16 (4x) were quite variable in vigor, and lobing and shape of leaves.

Thus of the F_1 species hybrids resulting from crosses of 1910 to 1925, one selection, NC 6-15 (2n) has been partially fertile and has occasionally set seed in controlled crosses and by open-pollination. Some of the second generation progeny have also been fertile. NC 6-15 (2n) at Raleigh, has not been completely hardy and in many years the canes are cold damaged or killed back to the trunk. This may account for some of the irregularity in fruiting. Vines of NC 6-15 (2n) at the present time are susceptible to black rot and mildew and are frequently defoliated in mid summer. Whether these are the same strains of the fungi that infect V. rotundifolia or the strains that infect Euvitis species is not known (If there is difference in strains). The berries which are developed are usually single seeded and too small to tell much about fruit qualities.

The seedlings of NC 6-15 (2n) in Raleigh resulting from open-pollination, presumably with V. rotundifolia pollen, have been much more susceptible to black rot and mildew than V. rotundifolia, less vigorous and productive than this species and not completely winter hardy. The seedlings from open-pollination of these selections are very susceptible to leaf spot from black rot. On the other hand, Mr. Dunstan's seedlings of NC 6-15 (2n) open and cross pollinated with Euvitis pollen have been more disease resistant than Euvitis vines adjacent to them.

It would appear that NC 6-15 (2n) does not carry sufficient genes from V. rotundifolia for disease resistance which would be one of the main objectives of this species-cross. However, NC 6-15 does indicate that some degree of fertility can be obtained in the F_1 at the diploid level, and more

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when the F_1 hybrid is made tetraploid. Different parentage for the first cross, transmitting greater resistance of V. rotundifolia and more fruit quality of Euvitis would be desirable. If such parents which are compatible cannot be found, NC 6-15 itself may serve as a bridge to overcome the sterility barriers. Cytological studies would be very helpful in determining the specific difficulties involved and in indicating possible means of solving them.

Present Program of Species Hybridization

Autopolyploids. The first tetraploid muscadine grapes from chromosome doubling by Dermen were planted in Raleigh, N. C. in 1954 and came into bloom that year. No tetraploid vines of bunch grapes were available for use as pistillate parents but pollen of tetraploid bunch grape varieties was obtained from Beltsville, Md., and used on the 4x muscadine varieties. No berries were set in any of 15 different crosses attempted (Table 21). Dermen also had negative results from similar crosses in 1954 with muscadine selections as the pistillate parents.

In 1955 small propagations of Niagara (4x) bloomed in the greenhouse but failed to set fruit with pollen from tetraploid muscadine selections. In 1956, six of ten crosses produced 74 seed from which 29 seedlings were grown, none of which were hybrid. In 1957, no seed were obtained from four crosses with 4x bunch grapes as the seed parents and none in 12 crosses with them as the pollen parents. In 1958, five crosses were tried but only one seedling resulted from a cross with Franklin (4x). In 1959, crosses were tried on eight tetraploid bunch grapes which produced 288 good seed all but four of which were from crosses with the male sterile Franklin (4x). An equal number of light seed also developed. Only 41 of the 288 seed germinated. Many of the seedlings were weak and only 28 were planted in the nursery. On March 1, 1961, 23 of these survived. Diaphrams at the nodes in 21 of the

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vines were not clearly defined which would indicate possible hybridity.

Thus crosses at the tetraploid level between bunch and muscadine grapes have produced few if any true hybrids. Crosses between tetraploids of other genera have been reported as being more difficult than similar diploid crosses. However, in the present case only a limited number of varieties have been tried as parents, and even at the diploid level many crosses have failed. More tetraploid varieties should be tried. This would be easier and many more pollinations could be made with less damage to flowers if pistillate varieties were used as the seed parents. Rarely is a good set of fruit developed on emasculated clusters. Damage to pistils and pedicels in mainpulation is severe. In addition considerable unwanted pollination during the operation is almost inevitable. It would be advisable to make a cytological examination of flowers and pollen of the proposed parents. A high percentage of the pollen from some colchicine produced tetraploids has been non viable.

Allopolyploids. Crosses between bunch and muscadine grapes at the diploid level have produced some diploid hybrids in the past and have done so in the current program (Table 22). In North Carolina, 8 diploid species crosses were unsuccessful in 1957 and 9 in 1958. In 1959, however, 753 sound seed were obtained in 15 of 18 crosses tried and 187 plants were grown. Only 57 of these were identified as true species-hybrids of which 54 were from crosses with Golden Muscat. There was one each in crosses with Fredonia, Niagara and Lutie, none in crosses with Concord or S.V. 12-375. These diploid hybrids were treated with colchicine in 1960 and 47 were moved to the vineyard in October. It is believed that chromosomes were doubled at least in 18 vines and that more vines with tetraploid shoots may be identified in 1961 after growth starts. One seedling, NC 226-11, (Golden Muscat x NC 60-60), produced a cluster of 32 berries on a tetraploid cane after treatment. These

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berries matured in late November 1960 and were of good size (3.8 grams each), averaged 22.5% total soluble solids and had a very fine aromatic flavor.

In 1960, a cross of (2n) Van Buren x (2n) NC 27-262 produced 131 seed.

In 1958, Dermen at Beltsville, obtained 708 seed from 6 diploid species crosses. These were planted at the N. C. Experiment Station in Raleigh and 301 plants grown and treated with colchicine and later 183 were planted in the vineyard. These were examined, cut back, etc. during 1960 and in October 145 were believed to be true hybrids of which probably 58 were successfully doubled.

Any of the species-hybrids from the colchicine treatments of 1959 and 1960 that are of interest because of vigor, plant characteristics, etc. but have not been successfully doubled should be retreated in 1961.

Triploids and Hexaploids. Several of the tetraploid muscadine plants developed in 1953 by Dermen with colchicine treatment were stunted and dwarfed. Many of the rooted propagations of the colchiploid plants have been slow growing and stunted. A high percentage of the seedlings from crosses and from open pollination of these original colchiploid muscadines has been slow growing and stunted.Poor growth habit has been reported as a fault of many tetraploid plants.

In contrast to this poor growth, triploid plants of other genera are often more vigorous than the diploid forms. Triploid plants are frequently sterile and unproductive but not necessarily so. It should be possible to regain fertility by doubling the chromosome number and it might be possible to do this without loss in vigor or good growth habit. Such hexaploid plants might make desirable selections themselves, or by crossing them with diploid plants, fertile tetraploids might result. From the uneven number of chromosome compliments, it should be possible to obtain progenies with genome dominance from either species parent in varying ratios.

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[illegible].

In 1959 three tetraploid bunch grape varieties were pollinated with pollen from three different diploid muscadine selections (Table 23). Very few seed were obtained from crosses on perfect flowered Dakota (4x) and Champanel (4x) which had to be emasculated and these seed failed to germinate. A good set of seed (761) developed on the male sterile Franklin (4x). A large number of light seed (floaters) was discarded.

Reciprocal crosses using pollen of M6-4A (4x) on 6 different diploid Euvitis varieties produced sound seed in each cross. However, the seedlings from these were identified as being entirely Euvitis and were discarded. These may have resulted from contamination or from cleistogamy which is known to occur in Euvitis. Some of the light seed and non-viable seed may have resulted from the true cross.

Germination of the seed in the crosses between tetraploid Franklin and diploid Muscadine selections was low and only 90 plants were produced. These were very vigorous and cytological examination showed them to be triploid. Intermediate morphological characters including absence of diaphrams at the modes confirmed that they were species hybrids.

These triploid species-hybrids were treated with colchicine. Penetration of the colchicine to the growing point in the buds of Franklin seedlings was difficult although the bud leaves developed mosaic patterns. (Less dificulty was encountered with seedlings of the other bunch grape varieties) A second treatment with removal of the bud scales and use of a cotton pad was more effective. Probable hexaploid shoots developed on 10 plants. It is hoped that more can be found when other buds grow in the spring of 1961. Foliage on shoots identified cytologically as having hexaploid tissue was abnormal and distorted with thick margins. Shoot tips and buds on some plants dried out, making cytological counts impossible. While these abnormalities may have indicated the limits of polyploidy,

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it is believed that other plants were doubled without exhibiting any serious defect. The growth in 1961 should be carefully watched and examined for more hexaploids.

In 1960 a cross of 2n Golden Muscat x (4x) NC 20-30 produced 82 seed. A similar cross with Van Buren failed to set any seed.

An inventory of the species-hybrid material at North Carolina Experiment Station, January 1, 1961, is given in Table 24.

Conclusions. Work has not progressed far enough in the hybridization of bunch and muscadine grapes to indicate how successful this will be toward the development of fertile hybrids. The need is great and its value to grape breeding and the grape industry would extend to all grape growing regions.

Several problems have been encountered. Species crosses have been difficult and unilateral at the diploid level and appear to be even more difficult at the tetraploid level. Combinations of more and different parents at both diploid and tetraploid levels should be tried in order to find compatable parents. These should be of the best available genetic material possible.

The number of present tetraploid varieties is limited and many of the best varieties of bunch, vinifera, and muscadine grapes are not available in tetraploid form. More of the best varieties of the various species should be treated and made available as tetraploids for breeding.

Where possible, pistillate (male sterile) parents should be selected for seed parents to avoid the difficulties and injuries of emasculation. This alone could increase the number of pollinations 1000 times and reduce the hazards to floral parts. Use of hormones in all crosses might increase the retention of flowers, fertilization and set of seed.

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Most seedlings in tetraploid crosses have been weak and slow growing, and many have been dwarf. Certain muscadine parents as Creek and NC 20-30 have had more vigorous progenies than other parents. Perhaps parental combinations can be found which will yield seedlings with good growth habits at the tetraploid level.

Making the species cross between diploids for subsequent doubling to alloployploids would make possible a wider selection of parentage immediately and would probably yield a larger number of F_1 hybrid seedlings. However, the number of individual plants to be treated with colchicine and identified as 4x would be greatly increased, and the routine identification of tetraploidy in colchicine treated species-hybrid seedlings has been difficult without comparable clonal hybrid material. Further generations of breeding would have to be at the tetraploid level with its related problems.

Because pistillate varieties and selections of high quality muscadine grapes are available, many more crosses with this species as the seed parent should be tried. Dearing obtained some F_1 hybrids in such crosses using pollen shipped long distances. Many combinations could be tried with comparatively little effort. Flowering dates of different species would more nearly coincide.

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Table 1 [illegible]

[illegible]

Introduced in 19[illegible] Bearing

[illegible]		[illegible]	[illegible]
[illegible]		Greenwell	[illegible]
[illegible]		Kilgore	[illegible]
[illegible]		Morrison	
[illegible]		New River	
[illegible]		Onslow	

[illegible]troduced in 1957 Bearing (perfect-flowered)

Introduced in 1957 by P. [illegible] [illegible] (perfect-flowered)

Table 1

New varieties originated in the Muscadine grape breeding program

Introduced in 1945 by Dearing

Perfect-flowered varieties	Pistillate varieties	
Burgaw	Cape Fear	Orton
Duplin	Creswell	Stanford
Pender	Kilgore	Topsail
Tarheel	Morrison	
Wallace	New River	
Willard	Onslow	

Introduced in 1957	Dearing (perfect-flowered)
Introduced in 1959 by N. H. Loomis	Magoon (perfect-flowered)

Table 2

Muscadine Grape Crosses (diploid)

	Parentage		Plants	Selections 1st	2nd	1957	1961	Remarks
	1946							
1	Scupp.	Burgaw	105	6	2	0	0	Sub-acid, good, dry scar, tough
2	"	Wallace	101	1	0	0	0	Acid, fair, tough, black rot, defoliated
3	"	Willard	253	3	1	0	0	Acid, poor, black rot, defoliated
4	"	Pender	59	3	0	0	0	Poor flavor, defoliated
5	"	Tarheel	138	10	4	3	1	Fair-good, mild, sweet, cluster, vigorous
6	"	Duplin	98	8	3	1	0	Acid, fair, oval, dull, med. large
8	"	G-52	79	2	0	0	0	Dull, musky, fair foliage
9	Topsail	Burgaw	332	10	4	4	3	Very good flavor, sweet, med. tough, mid season, dry scar
10	"	Wallace	107	8	3	1	0	Acid, dull, fair, mid late, wet scar
11	"	Tarheel	198	16	5	3	3	Very vigorous, sweet, insipid, cluster, thinner skin
12	Latham	Burgaw	349	9	5	3	3	Good flavor, sweet, early, dull, tough, dry scar
16	"	Wallace	102	3	1	1	0	Insipid, dots
17	"	Tarheel	207	17	7	3	1	Mild, insipid, med. early, soft, cluster
18	Thomas	Wallace	132	10	1	0	0	Acid, musky, tough
19	"	Burgaw	128	4	1	0	0	Very good flavor, tough, shell
20	"	Tarheel	238	10	5	2	2	Good, even ripe, vigorous, good foliage, cluster
21	Mish	Burgaw	281	0	0	0	0	Poor flavor, bad foliage, tough, shell
22	Cape Fear	Burgaw	113	3	2	1	0	Fair-good, shell
23		Wallace	174	4	2	1	0	Fair, sub-acid, dull, oval, tough
24		Tarheel	124	7	2	1	0	Attractive, poor flavor, oval, late
	Burgaw	Self	84	3	1	1	1	Sub-acid, good, tough, dry scar
	Wallace	Self	123	1	1	0	0	Fair, poor foliage
	Tarheel	Self	31	0	0	0	0	Soft, melting, thin skin
	Willard	Self	77	0	0	0	0	Acid, brown, early, defoliated
	Pender	Self	35	0	0	0	0	Very small, oval, late, yellow, good foliage
	Duplin	Self	2	0	0	0	0	Very small, ~~oval, late, yellow, good foliage~~

Table 2 (continued)

	Parentage		Plants	Selections 1st	2nd	1957	1961	Remarks
	3-B8	Self	128	0				
	11-B8	Self	41	0				
	5-B8	Self	57	0				
	88-B6	Self	82	0				
	94-B6	Self	67	0				
	55-B6	Self	22	0				
	61A-B6	Self	14	0				
	99-B6		10	0				
	1947							
25	Hunt	Burgaw	76	11	5	1	1	Sweet, fair, even ripe, black rot
26	"	Wallace	31	3	0	0	0	Poor, smooth skin, black rot
27	Lucida	Burgaw	412	39	9	4	4	Vigor, good flavor, fair, large, late
28	"	Wallace	162	24	7	1	1	Vigor, acid, poor, black rot, large, late
29	Creswell	Burgaw	255	24	13	5	5	Even, good flavor, sub-acid, dry scar
30	"	Wallace	131	8	2	0	0	Acid, poor, smooth skin, black rot
31	Smith	Burgaw	199	10	0	0	0	Poor
32	"	Wallace	81	1	0	0	0	Poor, shell
33	V21 R15 B2	Burgaw	135	15	10	5	4	Good flavor, high sugar, small, early
34	"	Wallace	118	6	0	0	0	Fair, sweet, shell
	Pender	Self	26	0				
	11-B8	"	13	0				
	5-B8	"	27	0				
	56-B6	"	1	0				
	88-B6	"	25	0				
	99-B6	"	15	0				
	94-B6	"	66	0				

Table 2 (continued)

No.	Parentage		Plants	Selections 1st	2nd	1957	1961	Remarks
	1948							
35	Beaufort	Burgaw	14	0	0	0	0	Not productive, weak, poor
36	"	Wallace	9	1	0	0	0	Not productive, weak, poor
37	Orton	Wallace	11	1	0	0	0	Not of cross
38	54-B6	Burgaw	14	1	0	0	0	Black rot, tough
39	Topsail	25-84	0					
40	Latham	G-52	1	0				
41	Smith	Burgaw	2	0				
	Duplin	Self	15	4	4	2	0	Melting pulp, acid
	Tarheel	"	45	0				
	1949							
42	Thomas	G-52	289	27	4	0	0	Cluster, good flavor, even, tender, vigor
43	"	37-10-1	221	36	7	1	0	Sweet, good, even, vigor
44	Scupp.	G-52	116	18	11	2	2	Sub-acid, good, tender
45	"	37-10-1	90	10	5	0	0	Sweet, tender
46	25-8-26	G-52	97	14	7	2	1	Musky
47	"	37-10-1	32	1	0	0	0	
	1950							
48	Memory	Burgaw	97	5	2	0	0	Not early, not large, black rot, poor
49	Beaufort	"	243	8	0	0	0	Not productive, black rot, poor
50	Scupp.	9-199	91	3	0	0	0	
51	"	11-101	129	8	0	0	0	Thin skin, sweet, tender
52	"	25-8-4	~~129~~	~~8~~	~~0~~	~~0~~	~~0~~	~~Thin skin, sweet, tender~~
53	"	37-11-1	186	16	6	1	0	Even, fair, acid, thin skin
54	Topsail	5-109	27	3	0	0	0	Vigor, resistant, very sweet
	9-199	Self	15	0				

Table 2 (continued)

No.	Parentage		Plants	Selections 1954	Selections 1957	Selections 1961	Remarks
	1951						
55	Scupp	20-193	204	15	1	0	Small, cluster
56	"	11-173	177	22	1	1	Sweet, cluster, large
57	Howard	"	126	11	1	1	Large, smooth, sweet, attractive
58	Yuga	"	145	16	2	1	Productive, cluster, late, oval, sweet, good
59	Lucida	"	104	10	2	1	Med. large, smooth, attractive, good flavor
60	25-8-26	"	157	25	2	1	Sweet, good flavor, attractive
61	Topsail	"	116	4	0	0	Small
62	Memory	20-193	32	2	0	0	Very poor
63	Hunt	"	151	15	1	0	Oval, small, cercospora
64	25-6-5	"	108	5	1	1	Large, poor foliage
65	Dulcet	11-11	100	1	1	0	
66	"	11-113	58	3	1	0	All small, black, fair cluster
67	"	11-117	100	6	0	0	Sweet, fair, medium vigor
68	"	11-153	95	6	1	0	
69	"	11-173	74	9	1	0	#69 largest fruited
70	"	11-178	37	3	0	0	
71	"	17-117	104	1	0	0	
	5-45	Self	0				
	5-88	"	4				
	9-1	"	69				
	9-8	"	4				
	9-100	"	40				
	9-219	"	85				Note: Heavy losses in nursery rows, especially of selfed seedlings.
	11-104	"	20				
	11-117	"	89				

Table 2 (continued)

Parentage		Selections			
		Plants	1954	1957	1961
11-153	Self	59			
11-173	"	28			
11-178	"	17			
15-159	"	188			
17-71	"	28			
17-99	"	22			
17-107	"	39			
17-117	"	163			
17-123	"	5			
17-197	"	4			
17-125	"	18			
20-17	"	11			
20-40	"	45			
20-122	"	41			
20-127	"	123			
20-169	"	14			
20-193	"	44			
20-219	"	93			
22-2	"	54			
23-87	"	10			
24-24	"	31			
24-42	"	51			

Table 2 (continued)

	Parentage		Plants	Selections 1957	1958	1960	1961	Remarks
	1952							
	Duplin	Self	197	38	4	4	2	Soft pulp, acid, cluster, vigor, persistent
72	Latham	Duplin	148	8	2	3	2	Med. soft pulp, acid, fair, small, vigor, persistent
73	Topsail	"	119	11	6	5	2	Med. soft, sub-acid, cluster, vigor, persistent
74	Hunt	"	125	9	3	2	2	Soft, fair, persistent
75	Hunt	11-178	56	4	0	0	0	Productive, black rot, small, thin skin
76	6-98	9-308	2	0	0	0	0	
	1953							
77	Latham	20-119	198	14	8	7	6	Fine foliage, good flavor, cluster, persistent, even
78	Howard	5-63	10	2	0	0		Med. large, poor, black rot
79	Dulcet	20-119	89	5	1	1		Small, even, tight cluster, shiny
80	Thomas	17-197	205	21	8	7	4	Tough skin, mid late, cluster, tight, persist, good
81	Stuckey	11-178	82	8	4	2	2	Black rot, cluster, persistent
82	"	6-98	18	2	1	0	0	Acid
83	"	Dearing	57	3	1	1	1	Black rot, small, sweet
84	"	33-23	95	4	3	3	3	Black rot, small tough, sweet, sugar
85	Nevermiss	17-197	203	21	8	5	4	Productive, small, sweet, persist.
86	"	17-123	188	14	5	3	2	Small, cluster, productive, persist.
87	Topsail	20-40	172	9	7	5	3	High sugar, good, cluster, persist., even prod.
88	"	28-193	119	11	5	4	4	Med. large, smooth, good, good foliage
89	5-63	9-308	52	9	4	4	3	Vigor, sweet, good
90	9-308	5-63	3	-				
91	11-60	33-61	33	6	0	0	0	Early, black rot, high sugar
92	11-178	33-23	18	5	2	1	1	High sugar, small
93	15-165	20-119	39	1	1	1	1	V. sweet, v. small, tight cluster
94	19-125	5-106	10	2	1	1	1	Productive, tight cluster

Table 2 (continued)

	Parentage		Plants	Selections 1957	1958	1960	1961	Remarks
	1954							
95	Scupp.	48-2-1	199	13	6	2	2	Soft, acid, poor flavor, cluster, black rot
96	"	48-3-1	25	1	0			Soft, small, acid, black rot
97	48-2-7	20-119	0					
98	"	9-308	0					
99	"	17-123	0					
100	46-15	28-222	41	10	6	5	4	Very large, attractive, poor flavor, acid, smooth
101	46-7	27-229	43	6	3	3	3	Large, fair
102	46-66	29-156	10	0	0	0	0	Large, acid
103	44-88	27-229	54	6	2	1	1	Med. large, acid, fair
104	43-123	29-67	44	1	1	1	1	Fair, small, sweet
105	53-121	5-115	93	6	1	0	0	Fair, insipid, few with cluster
106	45-40	29-156	34	2	1	1	1	Cluster, small, black rot
107	"	27-229	3					
108	Topsail	44-47	189	12	5	4	3	Sweet, most small, good
109	"	44-232	203	16	7	7	7	Black, even, attractive, good
110	"	37-10-1	141	5	3	2	2	Cluster, sweet, good
111	Latham	27-229	130	12	4	3	2	Very cluster, acid, late, prod.
112	"	28-222	116	13	3	2	1	Large, sweet, shell, black rot, even
113	Scupp.	27-229	129	1	0	0		Black rot, small
114	"	28-222	172	1	0	0		Black rot, unproductive
115	25-8-26	17-123	200	52	12	8	3	Early, sweet, shell, vigor, good
116	"	29-156	200	22	7	6	4	Small, late, shell, sweet, good
	G-52	Self	31	0				Black, cluster, even, ripe, thick skin
	37-10-1	"	90	0				Poor foliage, weak, very small
	37-11-1	"	4					Very small
	25-8-4	"	0					
	#117-121	Tetraploid crosses see Table16.						

Table 2 (continued)

	Parentage		Plants	Selections 1957	1958	1960	1961	Remarks	
	For 1954 species crosses see Table16.								
	1955								
	#122-134	Tetraploid crosses - see Table.16.							
135	46-15F	29-32	13				0	Poor	Bad location
136	50-55	60-60	41	4			2	Med. large, smooth	
137	59-90	29-32	0				0		
138	45-40	27-262	1	1			0		
139	45-40	56-98	5	1			0	Poor	
140	45-40	?	4						
141	58-89	29-32	19					Poor	
	1956								
	#142-147	Species crosses see Table21.							
148	Lucida	Tarheel	208	9				Vigorous, good foliage, cluster, med. small, smooth	
149	Willard	Burgaw	4					Discarded	
	1957								
150	Topsail	60-60	122	22				Large, white, sweet, very good	Elimination before fruiting.
151	"	56-98	40	9				Sweet	
152	"	16-21	18	3				Good foliage	
153	Hunt	60-60	107	28				Black rot	
154	"	68-14	89	16				Black rot	
155	"	69-60	109	15				Black rot	
156	"	44-15	14	2				Black rot	
	#157-167	Tetraploid crosses see Table16.							
	#168-177	Species crosses see Table21.							

Table 2 (continued)

	Parentage		Plants	Remarks
	1958			
	#178-180	Species crosses see Table 21.		
181	Luola	60-60	13	
182	"	Burgaw	8	
183	Higgins	29-193	3	
184	"	60-60	7	
185	45-15	29-32	7	
186	58-89	"	35	
187	Yuga	Dearing	24	
188	Duplin S_1	29-47	2	
189	"	29-32	1	
	#190-198	Species crosses see Table 21.		
	1959			
	#200-233	Species crosses see Table 21.		
	234-265	Tetraploid crosses see Table 16.		
	266-270	Species crosses see Table 21.		
271	87-56	111-108	109	In nursery rows 1/1/61
272	80-169	95-167	202	
273	87-126	Duplin S_1	38	
274	92-9	109-21	244	
275	Topsail	111-108	137	
276	Higgins	88-102	146	
277	87-126	59-32	54	
278	58-89	109-120	115	
279	"	111-108	85	
	1960		Seed	
280	77-123	108-109	75	
281	80-68	95-162	200	
282	80-169	109-157	200	
283	87-56	108-109	57	
284	87-126	109-21	107	
285	100-29	84-92	106	
286	112-54	108-169	29	
287	115-38	77-21	45	
288	115-121	29-193	250	
289	115-146	109-21	300	
290	58-89	110-34	600	
291	Topsail	95-167	70	
292	Latham	111-108	10	
	#293-314	Species crosses see Table 21.		

Table 3

Summary of average ratings of progenies in muscadine grape crosses for vigor, resistance to black rot, size and sugar.

A. Vigor of all seedlings, rated 1-10

Seed parent and its rating		Pollen parents and their rating						
		Tarheel 8.0	Burgaw 6.0	Wallace 4.0	Willard 3.0	Pender 4.0	Duplin 5.0	G-52 5.0
Self		5.6	4.4	3.8	3.5	3.9		
Scuppernong	6.0	5.8	5.3	4.7	4.6	5.0	4.9	5.2
Topsail	9.0	7.1	6.4	6.4				
Thomas	6.0	5.7	4.8	5.4				
Latham	5.0	6.5	6.5	4.5				
Cape Fear	4.0	6.2	5.4	4.7				
Mish	6.0		4.6					

B. Resistance to black rot of all seedlings, rated 1-10

Seed parent and its rating		Pollen parents and their rating						
		Tarheel 8.0	Burgaw 8.0	Wallace 6.0	Willard 5.0	Pender 7.0	Duplin 6.0	G-52 5.0
Self		7.8	7.4	5.3	5.1	5.1		
Scuppernong	6.0	6.2	4.6	3.3	3.1	5.1	4.4	4.7
Topsail	9.0	7.8	6.7	5.2				
Thomas	8.0	8.1	7.7	7.2				
Latham	7.0	7.9	7.6	6.9				
Cape Fear	8.0	7.2	7.1	6.0				
Mish	5.0		6.0					

Table 3 (continued)

C. Berry size of perfect-flowered seedlings - Av. wt. in grams

Seed parent and its size		Pollen parents and their size						
		Tarheel 3.10	Burgaw 4.10	Wallace 4.20	Willard 3.50	Pender 3.50	Duplin 4.50	G-52 4.40
Self		1.82	3.21	2.70	2.71	2.90		
Scuppernong	5.5	3.31	3.37	2.97	3.32	3.55	4.30	3.60
Topsail	6.0	3.72	3.68	3.74				
Thomas	4.3	3.27	3.23	3.53				
Latham	4.6	3.41	3.51	3.06				
Cape Fear	5.0	3.41	3.77	3.57				
Mish	4.8		3.08					

D. Sugar of perfect-flowered seedlings - Percent total soluble solids

Seed parent and its sugar reading		Pollen parents and their sugar reading						
		Tarheel 16.4	Burgaw 16.2	Wallace 14.7	Willard 15.5	Pender 14.9	Duplin 14.0	G-52 10.3
Self		16.6	17.9	14.8	17.3	16.9		
Scuppernong	17.5	16.2	15.5	14.9	15.7	15.5	15.1	14.6
Topsail	22.7	17.9	18.7	15.9				
Thomas	18.4	17.0	17.7	15.4				
Latham	17.6	18.7	18.6	16.7				
Cape Fear	17.8	14.8	15.4	15.4				
Mish	15.6		17.5					

Table 4.

Summary of average ratings of progenies in muscadine grape crosses

Seed parent	Character and pollen parent							
	Vigor		Resistance		Berry size		Sugar	
	Burgaw	Wallace	Burgaw	Wallace	Burgaw	Wallace	Burgaw	Wallace
Smith	4.7	3.9	6.0	5.0	3.59	33.3	18.3	16.4
Creswell	4.7	4.2	5.4	4.7	3.97	35.1	17.5	16.4
Hunt	4.7	3.3	5.4	4.5	3.38	36.2	19.2	16.0
Lucida	5.1	4.2	5.0	4.3	4.45	45.9	16.1	15.6
V21R15B2	4.8	4.5	6.2	5.0	3.12	30.2	20.4	18.3

Table 5.

Summary of average ratings of progenies in muscadine grape crosses

Seed parent	Character and pollen parent							
	Vigor		Resistance		Berry size		Sugar	
	G-52	37-10-1	G-52	37-10-1	G-52	37-10-1	G-52	37-10-1
Scupp.	6.4	5.4	6.1	6.2	3.60	31.0	19.0	19.6
Thomas	6.7	6.8	7.0	6.7	3.04	32.8	19.2	18.3
25-8-26	6.5	6.8	6.4	6.7	3.75	34.5	17.8	

Table 6

Difference in berry size in relation to their sex and seed parent in progenies of grape crosses. Berry size as weight in grams of 10 berries.

Pollen parent	Sex of seedling	Berry size with different seed parents					Range grams
		Dulcet	25-8-26	Howard	Scupp.	Lucida	
11-173	⚥	28.9	35.7	40.1	42.8	54.7	25.0
11-173	♀	39.7	47.0	43.2	52.2	55.7	16.0
Increase	grams	10.8	11.3	3.1	9.4	1.0	
Increase	%	37.4	31.6	7.7	22.0	1.8	

Table 7

Differences in average berry size in grams in relation to sex and to pollen parent in progenies of grape crosses. Berry size as weight in grams of 10 berries.

Seed parent	Sex of seedling	Berry size with different pollen parents				Range by Parentage
		37-10-1	37-11-1	G-52	11-173	
Scupp.	⚥	28.5	31.9	31.6	42.8	14.3
"	♀	34.3	36.9	39.9	52.2	17.9
Increase	grams	5.8	5.0	8.3	9.4	
"	%	20.4	15.7	26.2	22.0	
25-8-26	⚥	32.3		33.2	35.7	3.4
"	♀	36.6		40.0	47.0	10.7
Increase	grams	4.3		6.8	11.3	
"	%	13.2		20.5	31.6	
Thomas	⚥	30.8		27.9		-2.9
"	♀	34.7		32.8		-1.9
Increase	grams	3.9		4.9		
"	%	12.7		17.5		

Table 8

General characteristics of progenies of different parents
Best parents starred

Beaufort. ♀ Used for productivity, results negative, weak, poor foliage poor flavor, acid.
Burgaw. ⚥ Good vigor, small cluster, dry scar, dull.
Cape Fear. ♀ Oval shape, late, poor malic acid flavor, insipid.
*Creek. ♀ Only N. C. seedlings are 4x Creek x open. Vigorous, good acid flavor.
*Creswell. ♀ Good flavor, sub-acid, fair cluster, dry scar.
Dearing. ⚥ Small, sweet, tough, good flavor.
Dulcet. ♀ Cluster, small size, fair flavor, average vine.
Duplin. ⚥ Soft melting pulp, very acid, cluster, fair berry size, oval, vigorous
Howard. ♀ Sweet, large size, attractive smooth skin, susceptible to black rot.
Hunt. ♀ Oval, smooth skin, susceptible to black rot.
*Latham. ♀ High sugar, good flavor, tough skin and pulp, vigorous
*Lucida. ♀ Large size, attractive smooth skin, low sugar, vigorous.
Memory. ♀ Used for early ripening, large size and determinate growth, results negative, seedlings poor, susceptible to black rot.
Mish. ♀ Used for its reputation for wine, seedlings poor, susceptible to black rot, n.g.
Nevermiss. ♀ Used in place of Scuppernong in progeny tests - fair.
Pender. ⚥ Oval, yellow, cross had few seedlings.
Scuppernong. ♀ Between 1910-1925 seedlings of this and of Thomas were better than other varieties used as parents. It was used as a parent in progeny tests. Scuppernong, at Willard, produced mediocre flavored seedlings, susceptible to black rot, shattering clusters. Scuppernong from Scott's Nursery produced better seedlings, but not as good as other parents.
Smith. ♀ Used for productivity, results negative, poor flavor, shell, low vigor.
Stuckey. ♀ Large size, sweet, susceptible to black rot.
*Tarheel. ⚥ Cluster, persistence, vigor, resistance to black rot, susceptible to downy mildew, sweet, mild, insipid, thinner skin, soft pulp, small size, continuous flowering.
*Thomas. ♀ Vigorous, productive, fairly resistant to black rot, sweet, good flavor, dull skin, small size.
*Topsail. ♀ Vigorous, resistant to black rot, not productive, very high sugar, mild good flavor, smooth skin.
Wallace. ⚥ Vigorous, susceptible to black rot, poor foliage, acid, low sugar, dull skin, loose cluster.
Willard. ⚥ Susceptible to black rot, poor foliage, low sugar.
Yuga. ♀ Good flavor, thin skin, oval, late, pink color, late ripening.
*V21 R15 B2. ♀ (seedling of Latham) high sugar, fine flavor, small size, tough skin, dry scar, early.
G-52. ⚥ (from "Hope") large size, cluster, thick skin, acid.
*25-8-26. ♀ (from "Hope") (also grown as 8-26, but not of current series) productive, acid, "Scuppernong" flavor, susceptible to black rot, vigorous.

Table 8 (continued)

37-10-1. ⚥ (from "Hope") productive,vigorous, cluster, acid, medium size.
*11-173. ⚥ (Topsail x Tarheel), vigorous, resistant, cluster, only one of series #11 to transmit any berry size.
11-178. ⚥ (Topsail x Tarheel), medium vigor, productive, insipid.
5-63. ⚥ (Scupp. x Tarheel) vigorous, cluster, mild, insipid fair.
5-106. ⚥ (Scupp. x Tarheel) vigorous, cluster, productive, acid, low sugar.
5-115. ⚥ (Scupp. x Tarheel) vigorous, cluster, productive, acid, low sugar.
17-123. ⚥ (Latham x Tarheel) cluster, vigorous, productive, resistant, some with Tarheel flavor, sweet.
*17-197. ⚥ (Latham x Tarheel) cluster, vigorous, productive, resistant, some with Tarheel flavor, sweet.
*20-40. ⚥ (Thomas x Tarheel) very cluster type, vigorous, productive, resistant, small, sweet, good flavor (20-30 should be as good a parent.)
*20-119. ⚥ (Thomas x Tarheel) very cluster type, vigorous, productive, resistant, small, sweet, good flavor (20-30 should be as good a parent.)
20-193. ⚥ (Thomas x Tarheel) very cluster type, vigorous, productive, resistant, small, sweet, good flavor (20-30 should be as good a parent.)
27-229. ⚥ (Lucida x Burgaw) large size, acid, low flavor, cluster, vigorous, productive.
*28-193. ⚥ (Lucida x Wallace) large size, smooth skin, attractive, acid, low flavor, cluster, vigorous, productive.
*28-222. ⚥ (Lucida x Wallace) large size, smooth skin, attractive, acid, low flavor, cluster, vigorous, productive.
29-67. ⚥ (Creswell x Burgaw) vigorous, productive, cluster, good flavor.
29-156. ⚥ (Creswell x Burgaw) vigorous, productive, cluster, good flavor.
33-23. ⚥ (V21 R15 B2 x Burgaw) high sugar, good flavor, small.
44-47. ⚥ (Scupp. x G-52) productive, vigorous, attractive, smooth skin, good flavor, good size.
44-232. ⚥ (Scupp. x G-52) productive, vigorous, attractive, smooth skin, good flavor, good size.
46-7. ♀ (25-8-26 x G-52) large size, smooth skin, acid, low sugar, vigorous.
*46-15. ♀ (25-8-26 x G-52) large size, smooth skin, acid, low sugar, vigorous.
59-32. ⚥ (Lucida x 11-173) should transmit size, cluster, smooth skin, attractive.
*60-60. ⚥ (8-26 x 11-173) size, smooth skin, attractive, cluster, good flavor, sweet.
Duplin S_1-(several) soft pulp, very acid, oval, cluster, vigorous. Back-cross with these should give soft pulp with better flavor and less acid.
64-53. ⚥ (from Beula) not used. Saved for use as parentage for size, fair flavor.

Table 9

Sources of various characteristics

Vigor: Tarheel, Topsail, Latham, Thomas, 17-123, 20-40, 20-119.
Resistance to black rot: Tarheel, Thomas, progenies of Tarheel.
Productivity: Tarheel, 20-119, 37-10-1.
Cluster: Tarheel, G-52, and their progenies.
Persistence: Tarheel, and Series #11, 17, 20.
High sugar: Latham, V21-R15-B2, Topsail and their progenies.
Large size: Lucida, Topsail, 11-173, 28-193, 28-222, 27-229.
Smooth skin: Tarheel, Lucida, Topsail.
Thin Skin: (relative) Tarheel.
High acid: Duplin, Creek.
Good flavor: Thomas, Latham, Creswell, 60-60, 20-40.
Oval shape: Duplin, Cape Fear.
Continuous flowering: Tarheel and progeny.
Soft & melting pulp: Duplin, Duplin S_1.

Susceptible to mildew = Tarheel.
Susceptible to black rot: Wallace, Willard.
Poor flavors: Tarheel, Cape Fear, Lucida (?).
Tough skin: Latham, Thomas.
Tough pulp: Latham.

Other Notes

Color: Light color is recessive. Some varieties like Thomas are homozygous black. There are other color factors in [redacted] varieties giving pink, red, purple, tan, yellow.

Memory and Lucida at Willard have maintained good green foliage through the summer and harvest when all other varieties have been chlorotic and defoliated. At first this was believed to be due to tolerance to poor soil conditions and wet feet. Both varieties are susceptible to black rot. It may have been due to tolerance or immunity to Pierce's disease or other virus. Inheritance unknown.

Determinate growth, not as long trailing canes as most varieties, Memory. Inheritance unknown.

Table 10

N. C. selections being tested by Southeastern Experiment Stations

Location and date sent

Selection	Mississippi		Georgia		Florida		Alabama	S. Carolina	
	Meridian	State College	Experiment	Tifton	Jay	Live Oak	Auburn	Columbia	Owen's Nursery
5-63				55	55				
5-115	55	55-56	55	55		57	56	56	56
11-173	55			55	55				
11-178	53	53	53-55	55	55		56	56	56
11-186	55	55-56	55	53	55	57	56	56	56
15-161	55	55	55	55	55		56	56	56
17-123	53	53-55	53-55	55	55		56	56	56
17-197	53	53	53-55	55	55				
20-30	53	53	53						
20-119		55-56		55	55		56	56	56
24-42	53	53-55	53-55						
25-59	56	56	56				56	56	56
27-128	56	56	56			57	56	56	56
27-262	56	56	56			57	56	56	56
29-193	56	56	56			57		57	
33-13	56		56				56	56	56
29-47						57			
29-115						57			

Table 11

Yields of muscadine varieties and selections at Central Research Station, Clayton, N. C. Pounds of fruit per vine.

Selection	1958	1959	1960	Variety	1958	1959	1960
5-63	32	75	75	Burgaw	12	33	70
9-1	14	44	60	Dearing	12	30	84
9-305 Albemarle	8	35	52	Dulcet	22	54	87
9-308	6	70	120	Duplin	19	42	90
11-173	19	38	97	Higgins	9	58	100
11-178	20	34	63	Howard	9	26	27
11-186	28	46	105	Hunt	13	62	131
15-161	12	25	41	Memory	-	2	7
15-165	9	21	62	Nevermiss	3	28	59
17-55	13	28	88	Onslow	13	31	39
17-197	16	51	78	Scupp. Scott		28	49
20-30	40	15	84	Scupp. Manteo		8	17
20-30 (4x)	20	24	41	Tarheel			30
20-119	39	82	151	Topsail		38	56
25-59	2	39	64	Yuga	3	63	66
27-128	8	26	46	B6-19	13	51	44
27-229	4	50	40	37-10-1	11	50	81
27-262 Pamlico	13	60	40	25-8-26	19	86	99
27-354	3	30	66	G-52		10	23
28-193	7	30	58	Ga 14-20		43	6
29-32	17	37	59	M 3	17	27	83
29-47	8	35	52	M 4	29	8	49
29-115	20	25	75	M 7	15	29	45
29-156	21	50	82	M10			5
29-193 Chowan	7	32	67	M12	14	39	67
33-9	8	22	52	M15	12	34	62
33-13	8	25	39	M16	5	27	36
33-98	12	19	39	M17		3	4
33-106	2	17	43				
44-15	13	30	44				
44-47	14	70	49				
46-15		19	27				
56-98	23	50	43				
57-56		28	78 Carlos				
58-89F	23	65	100				
59-32	32	60	136 Roanoke				
60-60	27	10	132 Magnolia				
64-53		42	7				

Table 12.

Growth and productivity of colchiploid vines and comparison of berry size and pollen with diploid vines.

	Vigor rating	Productivity rating	Berry size weight in grams		Pollen size microns	
	4x	4x	2n	4x	2n	4x
Vigorous						
Thomas	9	5	3.9	6.8	29-31	33-39
Creek	9	4	3.6	4.7	27-31	33-39
M47-9B	9	4	-	4.5	28	33-35
M51-9B	8	3	3.9	5.6	-	36-39
NC 17-123	8	7	3.9	5.3	30	33
NC 11-178	7	7	4.2	5.5	28-30	33-37
NC 20-30	7	7	3.3	5.9	31-33	35-38
M6-4A	7	5	4.0	5.0	28-30	34-38
Higgins	7	5	9.1	12.7		
Normal						
Hunt	6	1	5.7	7.0		
Lucida	6	3	-	7.1		
Dallas	6	0	-	-		
Dearing	6	3	3.7	4.4		
M7	6	5	3.7	4.8	30	37-39
Weak						
Topsail	5	2	5.4	6.3	27	33-38
Yuga	5	4	4.0	5.2	-	36-38
M14-5A	4	3	-	4.8	-	34-36
Dwarf						
Scuppernong	D	4	5.2	6.3	29	35-37
Dulcet	D	4	4.0	5.3	29	35-38
NC 17-197	D	4	3.8	4.0	29	33-39
M10	D	4	3.8	4.8	31	35-38

Table 13.

Distribution of propagations of 4x colchiploids

	U. S. Hort. Meridian Loomis	Georgia Experiment Fry	California Davis Olmo	Illinois Barrett	Alabama Davis	N. Carolina Greensboro Dunstan	Georgia Gay Owen
Dulcet	x						
Creek	x	x					x
Higgins	x	x					
Thomas	x	x					x
Topsail	x	x					x
Scuppernong							
Yuga	x	x					x
NC 11-178	x	x	x	x	x		x
NC 17-197	x						
NC 20-30	x	x	x	x	x	x	x
M7	x	x			x		x
M10	x				x		
M6-4A	x	x	x	x	x	x	x
M14-5A	x	x					x
M47-9B	x	x					x
M51-9B	x	x					x

Table 14.

Berry measurements of diploid and colchiploid vines of different selections 1954

Selection	Sample size No.	Berry size: Weight grams	Berry size: Diam. mm.	Seed: Per berry No.	Seed: Wt. 100 grams
2n Dulcet	20	3.8	18.5	3.8	4.25
4x Dulcet	73		19.2	2.3	5.57
2n Creek	10	1.8	16.6	3.3	5.03
4x Creek	95	2.6	16.9	2.4	6.39
2n M7	35	3.0	17.2	4.0	3.13
4x M7	117	3.5	17.9	2.9	4.51
2n M10	20	3.8	18.8	3.9	4.81
4x M10	102	5.2	20.8	2.4	6.28
2n NC 11-178	55	3.6	18.3	3.8	4.83
4x NC 11-178	368	4.0	19.2	2.4	6.34
2n NC 17-123	25	3.1	17.5	3.7	3.48
4x NC 17-123	49	4.4	19.1	3.0	5.60
2n NC 17-197	35	3.0	17.5	3.4	4.08
4x NC 17-197	53	4.1	19.0	2.4	6.01
2n NC 20-30	35	2.6	16.2	4.0	3.74
4x NC 20-30	14	4.7	19.9	3.4	5.74

Table 15.

Germination, survival and growth of tetraploid and diploid seedlings (1954 seed)

Type of cross	Germination %	Seedling No.	Survival 1st year %	Inches growth 1st year				Ave. height 2nd year feet
				1-6	6-12	12-24	24+	
4x pistillate x open	63.3	206	78.0	32.3	38.5	29.2	0.0	2.3
4x perfect fl. x open	67.7	817	63.2	50.4	29.6	19.9	0.0	1.5
2n pistillate x 2n	82.0	328	86.3	0.3	2.8	7.0	91.7	5.5
2n perfect fl. x self	36.0	165	84.2	5.0	21.7	44.6	28.8	3.4

Table 16.

Crosses with tetraploid muscadine grapes
(all parents are 4x unless otherwise marked.)

Year & cross	Parentage	Seed	Nursery	Planted	Survived	Selections 1960
1954	all tetraploid					
	Thomas x NC 11-178					
	Topsail NC 20-30	(Very few clusters on Scuppernong & Topsail)				
	Dulcet NC 17-123					
	Yuga NC 17-197	(Vines severely damaged when in bloom by 2-4-D)				
	Creek M 51-9-13					
	Scupp. M6-4A					
	M 47 -9B					
	M 14-5A					
	M 10					
	M 7					
	All of above selections x self					
	All of above selections x open					
Following seed obtained in above crosses						
117	(4x) Thomas x NC 20-30	3	2	2		0
118	(2n(Scupp. x (4x) M10	4	3	3	not of cross	
119	(2n) Scupp. x (4x) M47-9b	3	2	1		
120	(2n) Scupp. x (4x) M51-9b	3	0			
121	(4x) NC 11-178 x self	3	2	1		0
Following seed from open pollination of tetraploids saved and grown						
	NC 11-178 x open	532	421	275	72	1
	M6-4A x open	93	34	19	9	0
	M10 x open	48	22	13	0	0
	NC 17-197 x open	136	100	56	2	0
	NC 17-123 x open	151	102	50	23	1
	NC 20-30 x open	53	42	24	17	2
	M47-9b x open	16	7	5	1	0
	M14-5A x open	43	26	7	0	0
	M7 x open	158	63	17	5	0
	Thomas x open	52	4	3	2	0
	Creek x open	150	111	89	79	9
	Dulcet x open	75	65	50	18	1
	Yuga x open	53	20	17	9	0
1955	Most of bags and fruit lost in 3 hurricanes					
122	Thomas x NC 11-178	34	6	6	0	
123	Thomas x M10	14	1	1	1	
124	Thomas x M6-4A	2	1	1	1	
125	Yuga x NC 11-178	13	6	4	1	
126	Creek x NC 11-178	21	11	9	6	
127	Creek x M10	9	2	2	2	

4x muscadine crosses (continued)

Year & cross	Parentage	Seed	Nursery	Planted	Survived	Selections 1960
1955 (cont'd)						
128	Creek x M6-4A	13	5	5	3	
129	Scupp. x NC 11-178	23	3	3	3	
130	Scupp. x M10	5	4	3	2	
131	Creek x NC 20-30	84	19	17	13	2
132	Topsail x NC 17-197	2	1	1	1	
133	Thomas(4x) x NC 11-178(2n)	64	3	2	1	
134	Thomas(2n) x NC 11-178(4x)	69	14	9	8	1
	NC 11-178 x self	372	69	51	21	
	M10 x self	27	15	8	0	
	M6-4A x self	132	46	42	28	2
	M7 x self	76	27	23	0	
	M51-9b x self	10	8	7	0	
	M14-5A x self	7	4	2	0	
	NC 17-197 x self	198	22	18	0	
	NC 20-30 x self	270	29	25	13	
	M47-9b x self	40	8	5	0	
1957						
157	Dulcet x M47-9b	9	1	0	0	
158	Thomas x M6-4A	14	0	0	0	
159	Thomas x M47-9b	24	7	5	3	
160	Thomas x NC 20-30	25	13	12	11	
161	Topsail x M6-4A	0	0	0	0	
162	Topsial x M47-9b	4	1	1	1	
163	Yuga x M6-4A	7	0	0	0	
164	Yuga x M47-9b	0	0	0	0	
165	Yuga x Dearing	1	0	0	0	
166	Scupp. x NC 11-178	13	10	9	7	
167	Higgins x NC 11-178	24	0	0	0	
1958						
190	Yuga x Dearing	11	7	6	6	
	Higgins x M6-4A	0				
	Higgins x NC 11-178	0				
	Lucida x M6-4A	0				
	Lucida x NC 11-178	0				
	Dallas x M51-9b	0				
	Dallas x NC 20-30	0				
1959	(4x) x (4x)					
234	Higgins x NC 20-30	19	5			
235	Higgins x M51-9b	11	0			
236	Lucida x NC 20-30	5	0			
237	Lucida x M6-4A	4	2			
238	Yuga x NC 20-30	27	17			
239	Yuga x M6-4A	14	12			
240	Yuga x M51-9b	16	8			
241	Yuga x M47-9b	5	6			

4x muscadine crosses (continued)

Year & cross	Parentage	Seed	Nursery	Doubled Yes	?	
1959	(cont'd)					
242	Topsail x NC 20-30	6	7			
243	Topsail x M51-9b	8	6			
244	Topsail x M47-9b	3	3			
245	Creek x NC 20-30	73	51			
246	Creek x M47-9b	11	0			
247	Thomas x NC 6-4A	4	4			
248	Thomas x M51-9b	4	4			
249	Thomas x M47-9b	10	9			
	(4x) x (2n) for triploid					
250	Higgins x 20-30	3	0			
251	Higgins x 87-100	9	2		2	
252	Lucida x 87-100	34	12	2	1	
253	Lucida (2n) x 109-34	27	7	2	3	(all 2n)
254	Yuga x 20-30	183	9	3	2	
255	Yuga x 87-100	111	6	1	1	
256	Yuga x 109-34	29	4		1	
257	Topsail x 20-30	23	0			
258	Topsail x 87-100	10	0			
259	Topsail x 109-34	1	0			
260	Creek x 20-30	0				
261	Creek x 87-100	58	3		1	
262	Creek x 109-34	49	9	1		
263	Thomas x 20-30	14	0			
264	Thomas x 87-100	12	0			
265	Thomas x 109-34	62	0			

Table 17.

Hybridization of Vitis Rotundifolia With Other Species
(see note at bottom of Table 18)

Evitis Species	V. rotundifolia pollen			Reciprocal cross		
	Bags	Seeds	Seedlings	Bags	Seeds	Seedlings
Labrusca (species and Concord)	67	328	16	38	0	0
Vinifera (Malaga, Verdell, Black Hamburg, seedlings of Malaga)	52	516	65	52	14	4
Cinerea	18	49	5	22	3	2
Bicolor	23	110	3	23	0	0
Cordifolia	33	233	9	54	0	0
Bourquiniana (Herbemont)	45	341	95	51	4	1
Lincecumii	0	0	0	19	0	0
Aestivalis (species and Norton)	63	271	61	44	1	0
Arizonica	0	0	0	11	0	0
Californica	0	0	0	8	0	0
Baileyana	5	0	0	0	0	0
Vulpine	0	0	0	9	0	0
Candicans	0	0	0	6	0	0
Champini	10	0	0	0	0	0
Longii	10	0	0	0	0	0
Labrusca x Vinifera						
Niagara	0	0	0	6	0	0
Lindley	13	0	0	0	0	0
Wilder	2	0	0	0	0	0
Salem	2	0	0	5	0	0
Agawam	3	29	5	5	0	0
Marguerite	2	9	0	1	0	0
Labrusca x Aestivalis						
Gold Coin	8	17	8	0	0	0
Lincecumii x Ruprestris America	5	0	0	0	0	0
Lincecumii x Labrusca						
Beacon	8	187	2	2	0	0
Lincecumii x Bourquiniana						
Muench	2	21	4	0	0	0
Labrusca-Aestivalis-Vinifera						
Winchell	18	412	80	15	0	0
Total	389	2523	353	369	22	7

Table 18.

Hybridization of Vitis Rotundifolia

F_2 Generation

Cross	V. rotundifolia pollen			Reciprocal cross		
	Bags	Seeds	Seedlings	Bags	Seeds	Seedlings
Vinifera - Rotundifolia hybrids						
Hybrid selfed	32	2	0			
Hybrid x Hybrid	8	0	0			
Hybrid open pollinated	-	61	5			
Hybrid x Rotundifolia	17	0	0	45	10	6
Hybrid x Vinifera	8	0	0	12	42	2
Bourquiniana - Rotundifolia hybrids						
Hybrid selfed	15	0	0			
Hybrid x Hybrid	10	0	0			
Hybrid x Bourquiniana	6	0	0	0	0	0
Hybrid x Rotundifolia	10	0	0	17	0	0
Winchell - Rotundifolia hybrids						
Hybrid selfed	25	0	0			
Hybrid x Hybrid	5	1	1			
Hybrid open pollinated	-	24	0			
Hybrid x Rotundifolia	17	4	2	12	0	0
Hybrid x Winchell	6	0	0	0	0	0
Total	159	92	8	86	52	0

The data in Tables 17 and 18 are taken from a report of Muscadine Grape Breeding and Hybridization at the North Carolina Experiment Station by C. F. Williams. This paper was presented at the Annual Meeting of the Horticultural Section of the Southern Agricultural Worker's at Atlanta, Georgia in 1926 but was not published.

Table 19.

Summary of Diploid Crosses with NC 6-15 and NC 6-16

Year & Cross	Parentage	Seed	Nursery	Field	Selection
1954					
	2n NC 6-15 x open	52	24	12	7 (numbered 615-1, 2, 3, etc)
1959					
266	615-1 x open	43	24		
267	615-5 x open	225	38		
268	615-8 x open	52	26		
269	615-10 x open	32	16		
270	615-11 x open	167	96		
1960					
309	615-1 x 77-51	63	(each 615 selection was pollinated		
310	615-5 x 77-51	32	with Golden Muscat, Van Buren,		
311	615-8 x 77-51	33	muscadine 77-51, sib 615-11 and		
312	615-5 x 615-11	34	self, - only these set seed)		
313	615-11 x self	31			
1954 to 1959 - no flowers on 2n NC 6-15					
1960	2n NC 6-15 x open	0			
	2n NC 6-15 x Golden Muscat	0			
	2n NC 6-15 x Van Buren	0			
	2n NC 6-15 x Muscadine	0			
	2n NC 6-15 x self	0			

Table 20.

Summary of Tetraploid Crosses With NC 6-15 and NC 6-16

Year & Cross	Parentage	Seed	Nursery	Field	
1957					
177	4x NC 6-15 x open		11	10	
1958					
191	4x NC 6-15 x open	175	139	129	Seed from Dermen
192	4x NC 6-15 x 4x NC 6-16	50	10	7	
1959	4x NC 6-16 x self	0			
	4x NC 6-15 x 4x M6-4A	0			
1960					
300	4x NC 6-15 x open	31			
	4x NC 6-15 x self	0			
301	4x NC 6-15 x 4x NC 6-16	21			
302	4x NC 6-15 x 4x Champanel	6			
303	4x NC 6-15 x 4x US 520-2	2			
304	4x NC 6-16 x open	45			
305	4x NC 6-16 x self	16			
306	4x NC 6-16 x 4x Champanel	3	Without emasculation and possible selfs.		
307	4x NC 6-16 x 4x US 520-2	314			

Table 21.

Tetraploid Species Crosses

Year & Cross	Parentage	Seed	Plants	
1954	4x Thomas x 4x Loretto			
	4x Thomas x 4x Dakota			
	4x Thomas x 4x US 519-6			
	4x Topsail x 4x US 519-6			
	4x Yuga x 4x Loretto			
	4x Yuga x 4x Champanel			
	4x Yuga x 4x Dakota			
	4x Yuga x 4x US 519-6			No fruit set. Note that the muscadine was the seed parent. Plants were severely damaged by 2-4-D when in full bloom.
	4x Yuga x 4x US 520-2			
	4x Dulcet x 4x Loretto			
	4x Dulcet x 4x Dakota			
	4x Dulcet x 4x US 519-6			
	4x Dulcet x 4x US 520-2			
	4x Creek x 4x Loretto			
	4x Creek x 4x Dakota			
	4x Creek x 4x US 519-6			
1955	4x Niagara x 4x 11-178	0	on recently grafted plants in greenhouse.	
1956				
142	4x Niagara x 4x 11-178	35	8	
144	4x Niagara x 4x 20-30	4	2	
	4x Niagara x 4x 6-4A	0		
143	4x Campbell x 4x 11-178	9	4	Later identified as being <u>not</u> hybrid and discarded.
145	4x Champanel x 4x 11-178	15	13	
146	Champanel (4x) x 4x 20-30	8	2	
147	4x Champanel x 4x 6-4A	3	0	
	4x Loretto x 4x 11-178	0		
1957	4x 520-2 x 4x 11-178	0		
	4x Loretto x 4x 11-178	0		
	4x Champanel x 4x 11-178	0		
	4x Black Rose x 4x 11-178	0		
	4x Thomas 4x 519-6			
	4x Topsail x 4x Loretto	0		
	4x Yuga 4x Champanel			
	4x 520-6			
1958				
178	4x Champanel x 4x 6-4A	2	0	
179	4x Franklin x 4x 6-4A	12	1	
	4x Loretto x 4x 6-4A	0		
	4x Niagara x 4x 6-4A	0		
	4x Franklin ♀ x self	0		

Tetraploid Species Crosses (continued)

Year & Cross	Parentage	Seed	Plants
1959			
200	4x Franklin ♀ x 4x 6-4A	279	25
202	4x Lake Emerald x 4x 6-4A	0	
	4x Champanel x 4x 6-4A	0	
	4x Loretto x 4x 6-4A	0	
	4x US 520-2 x 4x 6-4A	0	
	4x Vergennes x 4x 6-4A	0	
1960			
298	4x Franklin x 4x NC 20-30	72	
299	4x Franklin x 4x M7	15	
308	4x US 3-7 x open	23	
314	4x NC 226-11 x self	20	(20 seed sent to Loomis Jan. 1961)

Table 22.

Diploid Species Crosses & Colchicine Treated

Year & Cross	Parentage	Good Seed	Plants Treated	Hybrid	Probably 4x
1957					
168	2 crosses bunch x muscadine		1 seedling not hybrid		
169-173	6 crosses muscadine x bunch		not hybrid		
1958	seed from Dr. Dermen				
193	SV 14-287 x NC 60-60	26	15	0	
194	Seneca x M-15	28	13	2	2
195	Seneca x M56-8c	35	19	0	
196	US 519-28 x M 56-8c	190	92	35	9
197	US 519-28 x M 16	237	98	87	34
198	US 519-28 x M 15	192	64	21	13
180	Lutie x NC 60-60	19	5	0	
1959					
219	Fredonia x NC 20-30	18	2	0	
	Fredonia x NC 27-262	0	0	0	
220	Fredonia x NC 60-60	92	5	1	? 1 weak
221	Niagara x NC 20-30	14	7	1	0
222	Niagara x NC 27-262	76	34	0	
223	Niagara x NC 60-60	48	22	0	
224	Golden Muscat x NC 20-30	126	43	21	5
225	Golden Muscat x NC 27-262	99	28	11	3
226	Golden Muscat x NC 60-60	83	31	22	10
227	Lutie x NC 20-30	8	3	0	
228	Lutie x NC 27-262	12	4	0	
229	Lutie x NC 60-60	10	1	1	
	Concord x NC 20-30	0			
	Concord x NC 27-262	0			
230	Concord x NC 60-60	30	2	0	
231	SV 12-375 x NC 20-30	17	11	0	
232	SV 12-375 x NC 27-262	78	24	0	
233	SV 12-375 x NC 60-60	42	13	0	
1960					
294	Van Buren x NC 27-262	131			

Table 23.

Triploid Species Hybrids

Species Crosses to Obtain Triploids.
Seedlings treated with colchicine to induce hexaploidy.

Year & Cross	Parentage	Good Seed	Plants Treated	Hybrid	Field	Probably Double
1959						
203	4x Franklin x 2n 20-30	326	21	21	15	4
212	4x Franklin x 2n 20-30	30	2	2	1	0
204	4x Franklin x 2n 27-262	246	14	13	10	2
211	4x Franklin x 2n 27-262	14	2	2	2	0
205	4x Franklin x 2n 60-60	145	51	51	49	4
206	4x Dakota x 2n 20-30	1	0			
207	4x Dakota x 2n 27-262	5	0			
209	4x Champanel x 2n 20-30	3	0			
210	4x Champanel x 2n 60-60	1	0			
213	2n Fredonia x 4x M6-4A	34	3	0		
214	2n Niagara x 4x M6-4A	24	5	0		
215	2n Concord x 4x M6-4A	25	1	0		
216	2n Golden Muscat x 4x M6-4A	61	12	0		
217	2n Lutie x Muscat x 4x M6-4A	32	7	0		
218	2n SV 12-375 x 4x M6-4A	32	17	0		
1960						
293	2n Golden Muscat x 4x NC 20-30	82				
	2n Van Buren x 4n NC 20-30	0				

Table 24.

List of Grape Material at N. C. Experiment Station, Raleigh, N. C.

January 1, 1961

I Muscadine

1. Overhead Arbor
   A. Varieties

Burgaw	Hunt	Scuppernong (Scott)
Dearing	Latham	Scuppernong (Manteo)
	Luola	Tarheel
Dulcet	Magoon	Thomas
Duplin	Memory	Topsail
Higgins	Nevermiss	Wallace
Howard	Onslow	Yuga

Meridian selections

M7	M16	M18	M36-2A
M15	M17	M19	M44-8C
			M45-9C

   B. Older numbered selections, breeding stock

B6-19 (Latham x Burgaw, Dearing) sib of Topsail
V21 R15 B2 (Latham seedling, Dearing) F. source of high sugar
G-52 (Thomas x Hope, Detjen) source of perfect-flower
25-8-26 (from Hope, Williams) F. productive, haney flavor, light
37-10-1 (from Hope, Williams) productive, light, perfect flower

1. C. Selections from McCullers

	Selection	Parentage		Vigor	Productivity	Resistance	Color	Size	Sugar	Yield lbs.	Remarks
	Ready for release - Tested in Georgia and Mississippi										
Pamlico	27-262	Lucida	Burgaw	8	6	7	W	65	16	50	Attractive, large, fair
Chowan	29-193	Creswell	"	7	7	7	W	60	18	60	Fine flavor, productive, early
	Ready for increase - further testing										
Ellerman	9-305	Topsail	Burgaw	6	6	7	B	57	18	55	Fine flavor, even, dry scar, good foliage
	11-173	Topsail	Tarheel	7	7	8	W	45	17	75	Loose cluster, sweet, mild, even?
	11-186	"	"	7	8	8	B	47	18	50	Cluster, late, sweet, mild
	27-128	Lucida	Burgaw	7	6	7	B	55	16	40	Large, even (see 27-354)
Magnolia	60-60	25-8-26	11-173	7	6	7	W	55	17	70	Large, attractive, v. good
	Very good										
	9-1	Topsail	Burgaw	6	6	7	B	47	17	50	Good flavor, dry scar, even, good foliage
	15-161	Latham	"	6	5	7	B	40	17	35	Good, sweet, early, scar
	15-229	"	"	6	6	7	B	45	17		Good, very early 8/25
	29-32	Creswell	"	6	6	6	W	50	16	50	Late, good, foliage
	29-115	"	"	6	6	6	B	50	17	50	Good, attractive, cluster
	29-156	"	"	7	7	7	W	55	16	60	Very good, cluster, foliage
	33-13	V21 R15 B2	"	6	5	6	W	42	17	35	Very good, scar, sweet
	33-98	"	"	7	5	8	B	52	19	30	Very good, sweet, scar, M. early
	44-15	Scupp	G-52	6	5	7	B	60	15	40	Good, attractive, scar, shiny, dots.
Carlos	57-56	Howard	11-173	6	6	6	W	50	16	50	Attractive, good
Roanoke	59-32	Lucida	"	7	8	7	W	55	16	80	Attractive, cluster, parent size
	Good										
	5-63	Scupp	Tarheel	7	8	7	W	43	15	75	Cluster, mild, productive
	9-308	Topsail	Burgaw	7	6	7	W	50	18	50	Flavor, scar, foliage
	15-165	Latham	"	6	5	6	B	42	18	40	Flavor, sweet, scar, early
	17-197	"	Tarheel	7	6	7	W	40	19	60	Prod., sweet, mild, uneven, loose cluster

Selection	Parentage		Vigor	Productivity	Resistance	Color	Size	Sugar	Yield lbs.	Remarks
20-30	Thomas	Tarheel	7	7	8	B	38	17	50	Prod., sweet, cluster - small
27-229	Lucida	Burgaw	7	6	6	W	65	15	45	Large, attractive
27-354	"	"	6	6	8	B	70	15	50	Large, scar, more acid than 27-262
29-47	Creswell	"	6	6	6	B	45	17	45	Good flavor, fair cluster
33-106	V21 R15 B2	"	7	5	6	B	50	18	35	Good flavor, sweet, scar, early
58-89F	Yuga	11-173	7	8	7	WR	60	16	80	Late, attractive, good cluster F
Stock										
20-119	Thomas	Tarheel	8	8	8	B	35	16	90	Prod., sweet, very cluster
28-193	Lucida	Wallace	6	6	6	W	60	15	45	Attractive, large, poor flavor, parent
28-222	"	"	7		7	W	60	15	-	Good parent for size.
44-47	Scupp	G-52	8	6	7	W	45	16	60	Fair, scar, foliage
46-15F	25-8-26	"	6	4	7	W	60	16	25	Attractive, pearl, acid, Parentage F
64-53	Beula F_1	x 20-193	5	5	8	B	82	16	-	Large, fair, source for size
Probable discard										
11-178	Topsail	Tarheel	6	5	6	W	40	17	40	Mild, insipid - (have 4x form)
17-55	Latham	"	7	6	6	W	45	19	50	Sweet, even, shell, poor foliage
33-9	V21 R15 B2	Burgaw	6	5	6	B	45	17	40	Sweet, good, scar.
56-98	Scupp	11-173	6	6	6	W	55	17	45	Good, cluster, mild, chlorotic

2. Vertical Trellis

A. Selections

Selection	Parentage		Vigor	Productivity	Resistance	Color	Size	Sugar	Remarks
Best									
77-21	Latham	20-119	8	8	8	B	43	18	Cluster, early, sweet, flavor, persist.
77-61	"	"	8	6	8	B	46	18	Cluster, V. good, foliage
81-41	Stuckey	11-178	8	8	8	W	50	18	Sweet, good, cluster
85-172	Nevermiss	17-197	7	8	8	W	55	17.5	Attractive, good, cluster, persist.
86-12	"	17-123	8	7	7	B	47	18	Early, even, cluster, good, soft, persist.
88-9	Topsail	28-193	9	7	8	W	55	16	Attractive, V. good, cluster, foliage
Dixie 88-102	"	"	9	7	7	W	45	20	Cluster, sweet, good, foliage
104-8	43-123	29-67	7	7	8	B	50	19	Loose cluster, even, good, sweet
108-109	Topsail	44-47	7	6	8	W	53	19	Attractive, V. good, foliage, early
108-169	"	"	7	6	7	W	68	18	Attractive, sweet, good, scar
109-21	"	42-232	8	7	8	B	55	20	Very good, even, cluster
109-157	"	"	8	7	7	B	60	19	Very good, even, cluster, foliage
110-34	"	37-10-1	8	8	8	W	47	18	Cluster, even, good, attractive
115-180	25-8-26	17-123	7	7	8	W	48	18	Very early 8/20, sweet, good, mild
Very good									
77-51	Latham	20-119	9	8	8	B	40	18	Very clustered, good, even, dull, early 9/1 persist.
77-108	"	"	8	7	8	B	50	18	Cluster, good, even, soft
77-194	"	"	7	8	8	B	42	18	Cluster, good, even, early 9/1, persist.
77-123F	"	"	8	5	8	B	65	17	Good, sweet, large, F
80-74	Thomas	17-197	6	7	8	B	50	17	Cluster, good, even
80-114	"	"	8	8	7	B	42	17	Cluster, even, good, good foliage, small
80-153	"	"	7	9	7	B	38	17	Cluster, even, good, persist.
80-169F	"	"	7	8	8	B	65	16	Cluster, large, good F
81-16	Stuckey	11-178	8	9	9	W	50	16	Cluster, good, even, persist.
83-52	"	Dearing	7	8	7	W	52	17	Cluster, attractive, good, uneven?
84-56	"	33-23	8	7	7	W	56	19	Very sweet, soft, good, scar

2. A. (continued)

Selection	Parentage		Vigor	Productive	Resistance	Color	Size	Sugar	Remarks
84-92	Stuckey	33-23	9	6	8	B	55	18	Sweet, good, even, scar
85-47	Nevermiss	17-197	7	7	8	W	50	19	Cluster, sweet, fair
85-122	"	"	9	8	9	W	48	17	Good, sweet, sub acid, cluster, late
86-156	"	17-123	8	7	9	W	52	17	Good, sweet, sub acid, cluster
87-56F	Topsail	20-40	7	6	6	W	71	18	Sweet, Cluster, uneven F
87-102	Topsail	20-40	8	6	8	W	45	19	Cluster, sweet, good, late
89-12	5-63	9-308	8	7	7	W	48	18	Sweet, good, oval, persist
89-40	"	"	8	7	8	W	55	19	Sweet, good, scar, foliage, soft
89-52	"	"	8	8	7	W	45	17	Cluster, attractive, pink, sweet, mild
92-18	11-178	33-23	8	8	9	B	45	16	Sweet, soft
93-26	15-165	20-119	6	9	8	B	50	16	Very cluster, very prod, good
101-12	46-7	27-229	6	8	8	W	65	15	Large, attractive, fair
103-35	44-88	"	8	8	9	W	68	14	Large, attractive, acid, low flavor
106-5	45-40	29-156	9	8	8	W	55	16	Good flavor, good foliage, sub acid
109-34	Topsail	42-232	7	7	8	B	48	19	Sweet, even sub acid, persist, M. early
109-82	"	"	8	7	7	B	55	19	Sweet, good, even, scar, persist, M. early
109-120	"	"	8	7	8	B	50	19	Sweet, good, even, foliage, persist, M. early
109-174	"	"	7	7	8	B	60	18	Sweet, good, even, scar, persist, M. early
109-186	"	"	8	7	8	B	50	19	Sweet, good, even, scar, persist, M. early
116-68	25-8-26	29-156	8	7	8	W	67	18	Oval, good, attractive, sub acid
136-22	50-55	60-60	8	7	8	W	70	16	Smooth, sweet, good
Good									
73-48	Topsail	Duplin	7	6	8	W	55	17	Oval, soft, cluster, large, good, acid, foliage
74-103	Hunt	"	8	6	6	W	55	17	Oval, cluster, even, attractive, soft
79-9	Dulcet	20-119	8	7	9	B	40	20	Large, loose cluster, soft, good, too small
80-68F	Thomas	17-197	7	7	8	B	75	16	Large, good cluster, good F
84-82	Stuckey	33-23	7	7	7	W	52	18	Very sweet, good, large, shell

2. A. (continued)

Selection	Parentage		Vigor	Productivity	Resistance	Color	Size	Sugar	Remarks
88-67	Topsail	28-193	8	7	8	W	65	18	Attractive, fair, uneven foliage
88-120	"	"	8	7	8	W	62	17	Attractive, fair, large
100-8	46-15	28-222	8	7	8	W	85	15	Smooth, Attractive, poor
100-23	"	"	8	6	7	W	70	15	Smooth, attractive, poor, purple
100-29F	"	"	7	6	8	W	80	15	Smooth, attractive F
100-40	"	"	8	7	7	W	72	15	Smooth, attractive, poor, purple
101-18	46-7	27-229	7	6	7	W	72	15.5	Smooth, attractive, good
108-74	Topsail	44-47	7	7	7	W	50	17	Good, sub acid
110-93	"	37-10-1	7	7	7	W	65	16	Good, cluster, foliage
111-47	Latham	27-229	8	7	8	B	47	15	Large, cluster, good, late
111-108	"	"	8	[illegible]	8	W	45	15	Very Large, cluster, acid, not attractive
111-113	"	"	8	8	8	B	46	16	Large, cluster, good, fair, persist.
112-65	"	28-222	7	6	7	W	67	16	Oval, purple, fair, shell
115-146F	25-8-26	17-123	8	7	7	W	73	17	Cluster, sweet, mild F
115-259	"	"	7	8	8	W	56	17	Sweet, mild, good
116-189	"	29-156	7	7	8	W	55	16	Sub acid, good, cluster
136-9	50-55	60-60	8	8	8	W	50	16	Mild, good, foliage
Stock									
Ds-56	Duplin	self	7	9	8	W	55	15	Cluster, v. soft, poor
Ds-127	"	"	7	6	8	W	45	15	Cluster, melting flesh
72-76	Latham	Duplin	8	6	8	W	55	17	Cluster, fair, soft
72-109	"	"	7	8	8	W	39	15	Cluster, very melting flesh
73-84	Topsail	"	7	6	8	W	50	15	Cluster, sub acid, good
74-110	Hunt	"	7	7	8	B	53	16	Cluster, melting, early
85-90	Nevermiss	17-197	8	6	8	W	50	15	Vigor, foliage, fair
94-4	19-125	5-106	7	8	8	B	55	14	Very cluster, prod. acid, fair
95-162	Scupp	48-2-1	7	7	8	B	55	15	(Duplin x Self) soft, acid
95-167	"	"	7	7	8	W	55	16	(Duplin x Self) soft, acid, fair
101-35	46-7	27-229	7	7	7	W	55	14	Large, sub acid, fair
116-272	25-8-26	29-156	8	7	8	W	53	16	Attractive, sub acid, good

2. B. Seedlings Planted

Cross	No. Seedlings	
148	8	Lucida x Tarheel - Cross made to study inheritance of fruit size, and linkage with sex. 200 fruited, 8 selected in 1960. Medium size, thinner skin, mild, fair cluster.
150	22	Topsail x 60-60 - Cross for large attractive, sweet, light color, - Total 122. Started fruiting in 1960. Weak, pistillate, susceptible and small fruited discarded. 22 saved, many with fine flavor & attractive.
151	9	Topsail x 56-98 - Cross for sweet, good, light color. 40 seedlings. Most discarded in 1960. Black ones cannot be of cross.
152	3	Topsail x 16-21 - Cross of Topsail x vigorous, very resistant vine. Total 18 seedlings. 3 left.
153	28	Hunt x 60-60 - Cross for better quality Hunt. Total 107 seedlings. Reduced to 28. Should be some good seedlings.
154	16	Hunt x 68-14 - Quality & cluster. 189 seedlings reduced to 16. Bad foliage from black rot.
155	15	Hunt x 69-60 - Quality & cluster. Seedlings total 109. Weak and pistillate discarded.
156	2	Hunt x 44-15 - Cross of 2 good blacks. 14 reduced to 2
159	3	Thomas (4x) x 47-9B (4x)
160	11	Thomas (4x) x 20-30 (4x)
162	1	Topsail (4x) x 47-9B (4x)
166	7	Scupp (4x) x 11-178 (4x)

(tetraploid crosses)

2.B. (continued)

Cross	No. Seedlings		
181	13	Luola x 60-60	Luola might be the parent of Topsail
182	8	Luola x Burgaw	
183	3	Higgins x 29-193	Size x quality
184	8	Higgins x 60-60	Size x quality
185	8	45-15 x 29-32	Two good whites, cluster
186	34	58-89 x 29-32	Two good whites, cluster
187	24	Yuga x Dearing	For comparison with similar cross at 4x level
188	2	Duplin self x 29-47	For soft pulp & quality
189	1	Duplin self x 29-32	For soft pulp & quality
190	6	4x Yuga x 4x Dearing	

Crosses 159--190. Bad luck all thru. The year I had flu in May.

2. C. Seedlings in nursery rows - Crosses of 1959

Tetraploid

Cross	Plants	Parentage		
234	5	Higgins (4x) x NC 20-30 (4x)		
237	1	Lucida (4x) x M6-4A (4x)		
238	17	Yuga (4x) x NC 20-30 (4x)		
239	12	Yuga (4x) x M6-4A (4x)		
240	9	Yuga (4x) x M51-9B (4x)		
241	6	Yuga (4x) x M47-9B (4x)		
242	7	Topsail (4x) x NC 20-30 (4x)		
243	6	Topsail (4x) x M51-9B (4x)		
244	3	Topsail (4x) x M47-9B (4x)		
245	51	Creek (4x) x NC 20-30 (4x)		
247	4	Thomas (4x) x M6-4A (4x)		
248	4	Thomas (4x) x M51-9B (4x)		
249	9	Thomas (4x) x M4709B (4x)		
	Triploid	& colchicine treated	Doubled	
251	2	Higgins (4x) x NC 87-100 (2n)	2?	
252	11	Lucida (4x) x NC 87-100 (2n)	2 + 1?	
253	7	Lucida (2n) x NC 109-34 (2n)	2 + 3?	2n Arm on Lucida 4x
254	9	Yuga (4x) x NC 20-30 (2n)	3 + 2?	
255	6	Yuga (4x) x NC 87-100 (2n)	1 + 1?	
256	4	Yuga (4x) x NC 109-34 (2n)	1?	
257	3	Topsail (4x) x NC 20-30 (2n)		
261	3	Creek (4x) x NC 87-100 (2n)	1?	
262	9	Creek (4x) x NC 109-34 (2n)	1	
	Diploid			
271	109	87-56 x 111-108	Size, cluster, flavor x cluster	
272	202	80-169 x 95-167	Size, cluster, flavor x acid & soft	
273	38	87-126 x Duplin S127	Sweet, tender, size x soft pulp	
274	244	92-9 x 109-21	Yield, sugar, small x size, sugar	
275	137	Topsail x 111-108	Quality x cluster	
276	146	Higgins x 88-102	Size x cluster, size, flavor	
277	54	87-126 x 59-32	Sweet, tender, cluster x attractive	
278	115	58-89 x 109-120	Late, quality x flavor, sugar	
279	85	58-89 x 111-108	Late, quality x cluster	

2. D. Seed sown February 6, 1961 - 1960 crosses

Cross	Seed	Parentage	
280	75	77-123 x 108-109	Cluster, size, flavor x size, attractive & sugar
281	200	80-68 x 95-162	Cluster, flavor, size x acidity, soft
282	200	80-169 x 109-157	Cluster, flavor, size x even, flavor
283	57	87-56 x 108-109	Size, sugar x size, sugar, attractive
284	107	87-126 x 109-21	Sugar, cluster, tender x sugar, cluster, flavor
285	106	100-29 x 84-92	Size, no flavor x size, sugar
286	29	112-54 x 108-169	Size, sugar x size, flavor, attractive
287	45	115-38 x 77-21	Cluster, size x cluster, flavor
288	250	115-121 x 29-193	Cluster, size x quality
289	300	115-146 x 109-21	Cluster, size x cluster, even, flavor
290	600	58-89 x 110-34	Quality, late x cluster
291	70	Topsail x 95-167	Sugar, quality x acid, soft
292	10	Latham x 111-108	Sugar x cluster

To use in crosses pistillate vines saved before discarding most of them.

2. E. Tetraploid Muscadine Selections

Plants	Parentage	Selection Symbol
2	NC 11-178 (4x) x self	
1	NC 20-30 (4x) x open	
1	NC 17-123 (4x) x open	
1	M6-4A (4x) x open	
1	Dulcet (4x) x open	
9	Creek (4x) x open	C47, C57, C62, C72, C79 C90, C98, C102, C105
3	Creek (4x) x NC 20-30 (4x)	131-1, 131-5, 131-12
1	Thomas (2n) x NC 11-178 (4x)	134-8 (3x)
	(also 3 propagations of 134-8 (3x) colchicine treated)	

List of Grape Material at N. C. Experiment Station - Raleigh, N. C.

January 1, 1961

II Species Hybridization

A. Parental material

a. 4x bunch grapes

Lake Emerald	Niagara	Compbell
Franklin	Dakota	Vergennes
Champanel	Loretto	US 520-2

b. 2n bunch grapes at Clayton

Stuben	S 9110	S.V. 12-375
Golden Muscat	S 8357	S.V. 12-303
Buffaloe		

c. original colchiploids (4x)

Thomas	Scuppernong	NC 20-30
Topsail	Dearing	M 7
Yuga	Lucida	M 6-4A
Creek	Higgins	M 14-5A
Dulcet	NC 11-173	M 47-9B
Hunt	NC 17-123	M 51-9B
Dallas	NC 17-197	

B. Species-hybrid selections

a. Vinifera-Rotundifolia
NC 6-15 (2n), NC 6-15 (4x), NC 6-16 (4x), B4-5(2n)

b. Derived from (a) by Dunstan
D56. DRX 55, D2

c. NC selections of NC 6-15 (2n) x open
615-1, 615-3, 615-5, 615-8, 615-9, 615-10, 615-11

d. US selections of (Franklin x Dearing)
US 3-1, US 3-2, US 3-3, US 3-4, US 3-5, US 3-6, US 3-7, US 3-9

d. (New) Golden Muscat x NC 60-60
NC 226-11

C. Species-hybrid seedlings (not colchicine treated)

Year	Cross	Plants	Parentage	
1957	177	4	NC 6-15 (4x) x open	
1958	191	129	NC 6-15 (4x) x open	
1958	192	7	NC 6-15 (4x) x NC 6-16 (4x)	
1959	266	24	NC 615-1 (2n) x open	
1959	267	38	NC 615-5 (2n) x open	
1959	268	26	NC 615-8 (2n) x open	
1959	269	16	NC 615-10 (2n) x open	
1959	270	96	NC 615-11 (2n) x open	
1959	200	20	Franklin (4x) x M6-4A (4x)	~~1959~~ nursery
1959	202	5	Franklin (4x) x M6-4A (4x)	~~1959~~ nursery

1. D. 2n Species hybrid seedlings (colchicine treated)

1958 Cross	Number	Parentage	Probably Doubled
194	2	Seneca x M 15	2
196	35	US 519-28 x M 56-80	9
197	87	US 519-28 x M 16	34
198	21	US 519-28 x M 15	13
1959			
220	1	Fredonia x NC 60-60	1 ?
221	1	Niagara x NC 20-30	0
224	21	Golden Muscat x NC 20-30	5
225	11	Golden Muscat x NC 27-262	3
226	22	Golden Muscat x NC 60-60	10
229	1	Lutie x NC 60-60	0

(The above will need cutting back and selecting in 1961. Many should flower. Several good 2n hybrids. Among the 1959 seedlings more 4x should be found in 1961.)

1. E. 3x Species hybrids, (Colchicine treated)

1959			
203	15	Franklin (4x) x NC 20-30 (2n)	4
212	1	ditto	0
204	10	Franklin (4x) x NC 27-262 (2n)	2
211	2	ditto	0
205	49	Franklin (4x) x NC 60-60 (2n)	4

2. E. Crosses of 1960, seed planted 2/6/61

Cross	Seed	Parentage
293	82	Golden Muscat (2n) x NC 20-30 (4x)
294	131	Van Buren (2n) x NC 27-262 (2n)
295	17	Van Buren (2n) x self (for comparison)
296	200	Van Buren (2n) x open (for comparison)
297	150	Golden Muscat x open (for comparison)
298	72	Franklin (4x) x NC 20-30 (4x)
299	15	Franklin (4x) x M 7 (4x)
300	31	NC 6-15 (4x) x open
301	21	NC 6-15 (4x) x NC 6-16 (4x)
302	6	NC 6-15 (4x) x Champanel (4x)
303	2	NC 6-15 (4x) x US 520-2 (4x)
304	45	NC 6-16 (4x) x open
305	16	NC 6-16 (4x) x self
306	3	NC 6-16 (4x) x Champanel (4x)
307	314	NC 6-16 (4x) x US 520-2 (4x)
308	23	US 3-7 (4x) x open = (Franklin 4x x Dearing 4x)
309	63	NC 615-1 (2n) x NC 77-51 (2n)
310	32	NC 615-5 (2n) x NC 77-51 (2n)
311	33	NC 615-8 (2n) x NC 77-51 (2n)
312	34	NC 615-5 (2n) x NC 615-11 (2n)
313	31	NC 615-11 (2n) x self
314	20	NC 226-11 (4x) self = (Golden Muscat x NC 60-60)

Figure 1. Comparison of size of berry of 2n and 4x vines in relation to the number of seed per berry

x = tetraploid
o = diploid

Number of berries classified by number of seed per berry

diameter of berry in mm.	1	2	3	4	5
22			x xx	x	
21		xx xx	xxx xxx		
20		xxxxx xxxxx xxxxx xxxxx	xx x o	oo oo	o
19		xxxx xxxx xxx	o	oo o	
18	xxx xx	xx x	oo o	oo oo	o
17	xx xx	xxo	o		

NC 11-178

Figure 2. Comparison of size of berry of 2n and 4x vines in relation to the number of seed per berry (continued)

x = tetraploid
0 = diploid

Number of berries classified by number of seed per berry

diameter of berry in mm.	1	2	3	4	5
24			x	xx xx	
23				xxxx xxxx	
22		x	xxxx xxxx	x	
21		xx	x		
20					
19			ooo oo	oooo oooo ooo	
18			oo o	ooo ooo	

NC 20-30

Figure 3. Comparison of size of berry of 2n and 4x vines in relation to the number of seed per berry (continued

x = tetraploid
o = diploid

Number of berries classified by number of seed per berry

diameter of berry in mm.	1	2	3	4	5	6
21			xx xx	xx		
20		xx	xxx xxx	x	o	oo
19		xxxx xxx	xx x	oooo oooo oooo	o	o
18			oo	ooo ooo		

M7

Figure 4. Comparison of size of berry of 2n and 4x vines in relation to the number of seed per berry (continued)

x = tetraploid
o = diploid

Number of berries classified by number of seed per berry

diameter of berry in mm.	1	2	3	4	5
24			xx		
23		x	xx xx	x xx	
22		xx xxx	xxxx xxxxx xxxx	x	
21		xxxx xxxxx xxxxx xxxxx	xxx xxx xxx	x	
20	x	xxxxx xxxxx xxxxx xxxxx	xx xx	x o	
19	xx x	xxxx xxx	x	oooo oooo oooo	
18		xxo	ooo oo	ooooo oooo oooo oooo	
17	xx	x	oo oo	ooo oo	
16	x				

M10

Magnolia N° 24–145

N° 5

India

1. NC 111-108 Latham x (Lucida x Burgaw) Light fruited selection with large clusters of persistent berries. Clusters with desirable long stems.

2. NC 94-4 (Thomas x Burgaw) x (Scuppernong x Tarheel) Dark fruited selection with large compact clusters. Vine is very productive, but the fruit is rather acid.

Magnolia

3. NC 60-60 25-8-26 x (Topsail x Tarheel) Light fruited selection, with large fine flavored fruit.

[illegible]

4. NC 59-32 Lucida x (Topsail x Tarheel) Light fruited selection with large, very attractive berries.

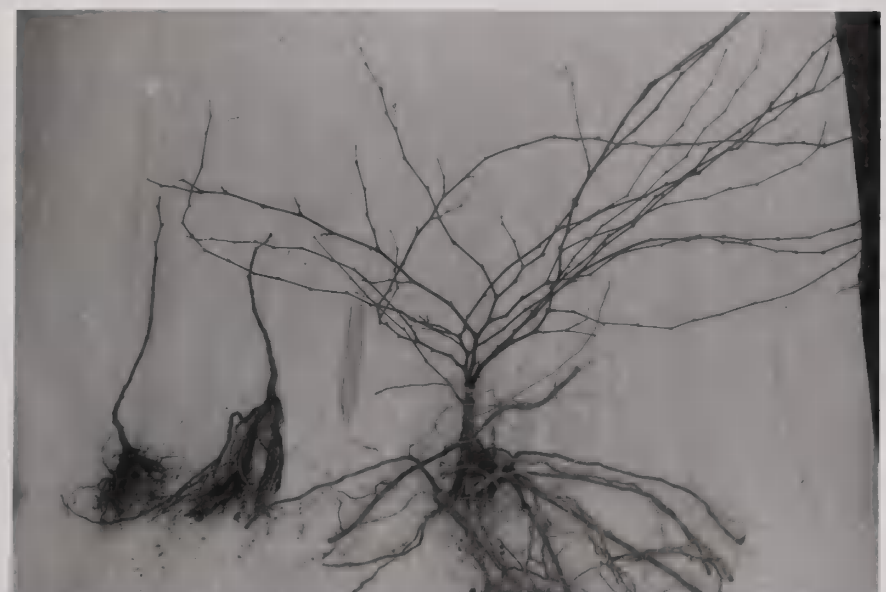
5. NC 89-48 (Scuppernong x Tarheel) x (Topsail x Burgaw) Very productive, light fruited selection. Berries attractive and fine flavored.

6. NC 93-26 (Latham x Burgaw) x (Thomas x Tarheel) Very productive, black fruited selection. Clusters too compact and short stemed for easy harvesting. Sweet and good flavored.

7. Creek (4x) Original colchiploid vine showing very good vigor, equal to that of the diploid form. Canes are of the past season, unpruned.

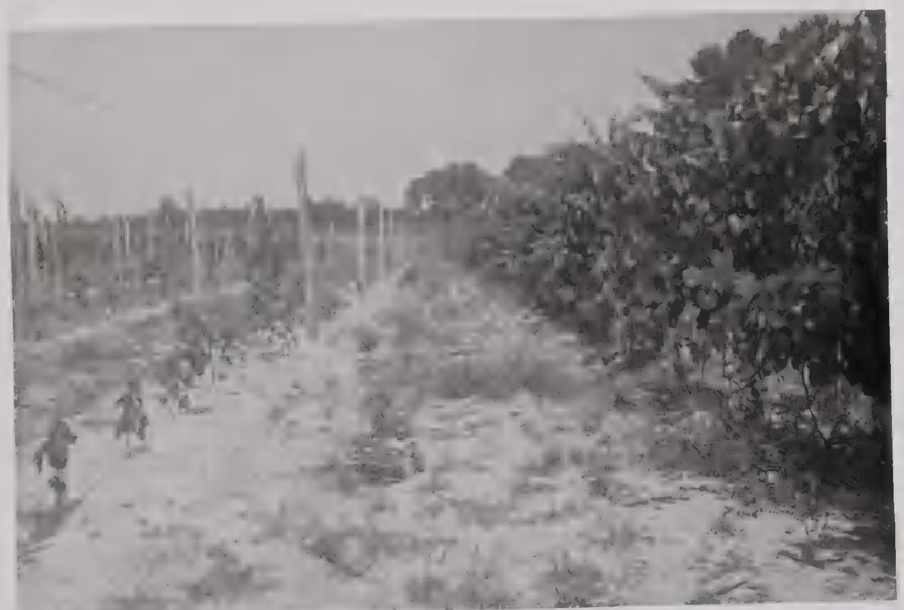
8. Dulcet (4x) Original colchiploid showing severe dwarfing. Vine is the same age as Creek vine in Figure 7. Photo taken from shorter distance and the vine appears proportionally larger than it is in comparison with Creek. Canes show several years of growth.

9. Berries of 2n (left), and 4x (right) of NC 20-30, showing difference in size.



10. Two year old seedlings of 4x (left) and 2n (right). Note the short compact root systems and short internodes of the 4x seedlings.

11. One year old seedlings of 2n crosses (left) and 4x crosses (right).



12. Two year old seedlings of 4x crosses (left) and 2n crosses (right).

13. NC 6-15 (2n) Many of the canes on this vine were winter injured.

14. NC 615-11 (2n). Seedling from open pollination of NC 6-15 (probably by V. rotundifolia). This seedling is perfect-flowered, fertile, and has a relatively large flower cluster.

15. Row of colchicine treated species hybrids. Cross of 1958, treated 1959, photo September, 1960.

16. Species-hybrids treated with colchicine.

17. NC 226-11 (4x) (Golden Muscat x NC 60-60). Cluster on colchicine treated species-hybrid, first year from seed. Cluster of 32 berries, averaging 3.8 grams each, 22.5% total soluble solids, excellent flavor.

18. Picking frame for harvesting grapes from overhead arbor. Fruit can also be placed directly into containers set on frame.

19. Picking frame for harvesting. Berries can be graded and packed as they roll out.